# 6080A

## SYNTHESIZED RF SIGNAL GENERATOR

# Calibration and Performance Testing

868914
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FLUKE

# Calibration and Performance Testing
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SECTION 1
CLOSED CASE CALIBRATION

## 1-1. INTRODUCTION

The procedures in this section calibrate the rf level, AM depth, FM deviation, and the internal 10-MHz reference oscillator without removing the instrument covers. You can perform the procedures directly by pressing the front panel keys, or remotely under the control of an IEEE-488 bus controller.

Perform the calibration procedures at the specified 2-year calibration intervals or as needed to optimize 6080A Synthesized Signal Generator performance.

These calibration procedures cannot correct hardware failures.

Each procedure includes the following steps:

1. Set the rear panel CAL|COMP switch to the 1 (on) position.
2. Initiate the calibration procedure.
3. Connect the required measurement equipment to the signal generator's rf output.
4. Adjust the parameter of interest until the meter reading matches a predetermined target value.
5. Store the updated calibration factor.

## 1-2. Front Panel Calibration

The front panel calibration procedures describe the steps required to perform each test. The edit knob increases or decreases the bright-digit value. You must adjust the bright-digit value until the 6080A reading matches the target value.

## 1-3. Remote Calibration

The remote calibration procedures allow the signal generator to be automatically calibrated by an IEEE bus controller. When equipped with the required measurement equipment and bus controller software, calibration consists of simply connecting cables to the instruments and executing the program.

The basic structure of a calibration program is shown in Figure 1-1.

```
Initiate 6080A calibration procedure
Initialize measurement equipment

Main Loop
    Ask 6080A for rf frequency
    Exit loop if frequency is special end code "9E+09"
    Get reading from measurement equipment
    Send reading the 6080A
    End loop

Save calibration data
Exit calibration procedure
```

**Figure 1-1. Basic Structure of Calibration Program**

A remote calibration procedure begins when the bus controller initiates the firmware calibration program, located in the signal generator, and initializes the measurement equipment. The controller then requests the signal generator's rf frequency and waits for a response. The controller requests the rf frequency each time through the main loop to synchronize the controller with the signal generator and to provide an exit point when the procedure is complete.

When the bus controller receives the response from the signal generator, it gets a reading from the measurement equipment, ensures the reading is settled and valid, and converts the reading into a format understood by the signal generator. The controller then sends the reading to the signal generator, which uses the reading to update its internal settings. The signal generator does not respond to the next frequency query until it is ready for another reading. The controller waits for the signal generator's output to settle before taking another measurement reading.

The signal generator continues to receive readings and make internal adjustments until it gets two consecutive readings within the error tolerance for the procedure. The error tolerance is defined for each procedure as a range of readings around the target value that the signal generator expects to receive when the adjustment is correct. When two readings are within the error tolerance, the adjustment is considered valid.

The program remains in the main loop until the signal generator returns the end code "9E+09 HZ", in response to the next frequency query. When the controller receives the end code, it exits the loop and saves the measurement data in the signal generator's calibration memory.

The division of responsibility between the controller and signal generator allows the use of measurement equipment from various manufacturers. Adding a different meter to the system requires only that a new driver module be written for the controller.

NOTE

The accuracy of the remote calibration procedure depends largely on the design of the controller software. Determine that the readings are settled, and average several readings before sending the result to the 6080A. Where applicable, apply meter-specific calibration factors to the readings.

Sample controller programs for each remote procedure are included in Appendix B. The programs are written in Fluke BASIC and are provided as examples of the programs that run on a Fluke 1722A controller.

## 1-4. Calibration Data

After making internal adjustments, the signal generator stores calibration data along with compensation data in non-volatile memory. Two copies of data provide a redundant storage scheme to enhance data integrity. The two copies are stored in separate locations: one copy is stored in the battery-backed RAM and an identical copy is stored in the EEPROM.

The calibration data are generated in one of two ways: by the Fluke factory or by the user. Each calibration data segment contains a data origin code that specifies how the data segment was created.

The calibration and compensation data origin codes display when special function 05 is entered. Origin code 00 signifies that the data originated at the Fluke factory, therefore no user calibration or compensation procedures have been performed.

Special function 05 displays the calibration and compensation data origin codes. If no user calibration or compensation procedures have been performed, the special function displays origin code 00 to signify that all of the data originated at the Fluke factory. If any user calibration procedures have been performed, the corresponding code is displayed. For example, if the AM calibration procedure has been performed by the user, the data origin special function will display the code 528. A complete list of the data origin codes is given in Appendix A.

Refer to the Operator Manual for more information about special functions.

## 1-5. CALIBRATION SET-UP

Before beginning the procedures, set the rear panel slide switch labeled CAL|COMP to the 1 (on) position. Setting the rear panel switch to this position causes the CAL and COMP annunciators to flash, indicating that a calibration procedure can be selected when SPCL is pressed. When a calibration procedure is initiated, the CAL and COMP annunciators stop flashing and the CAL annunciator remains lit until the procedure is complete. When the rear panel switch is in the 0 (off) position, the data is write-protected in hardware.

## 1-6. AM CALIBRATION

The AM calibration procedures allow a single point calibration of the AM depth. An rf modulation meter is connected to the 6080A's rf output and the AM calibration factor is adjusted based on the meter reading. The parameters specific to this procedure are listed below:

- Adjustment Range: +/- 5% AM Depth
- Adjustment Resolution: 0.1%
- Target Value: 50.0%
- RF Frequency: 300.000000 MHz
- RF Level: +10.0 dBm
- Internal AM: ON
- Modulation Frequency: 1 kHz
- External Equipment: RF Modulation Analyzer (HP 8901A or equivalent)

When performing the front panel procedure, use the edit knob to adjust the am depth until the measured AM depth matches the target value. During the remote calibration procedure, a program running on an IEEE-488 bus controller directs the procedure.

Both the front panel and remote calibration procedures reconfigure the front panel display in the following ways: the target level displays in the modulation field, the rf frequency displays in the frequency field, the adjustment value displays in the amplitude field, and the CAL annunciator lights.

All adjustments update a temporary copy of the AM calibration factor. The copy in the calibration memory updates only after the store command is given explicitly. After the store command has been given, the internal calibration factor is calculated from the displayed adjustment value and is stored in the calibration memory. Subsequent AM programming commands use the new calibration factor.

## 1-7. Front Panel AM Calibration Procedure

This procedure disables several of the front panel controls or causes them to operate differently than they normally do. It also reconfigures the display.

Table 1-1 lists the front panel controls used in the calibration procedures and describes the function of each.

Proceed as follows to perform the front panel AM calibration procedure:

1. Set the rear panel CAL|COMP switch to 1 (on) position.

2. Enter special function 991 to initiate the AM calibration procedure.

3. Connect the rf output of the 6080A to the modulation meter.

4. Select the peak+ mode, enable the 50-Hz high-pass filter, and enable the 3 kHz low-pass filter on the modulation meter.

5. Use the edit knob to change the adjustment value until the modulation meter reads 50.0%.

6. Press [STO] twice to store the new data.

**Table 1-1. Front Panel Controls for AM Calibration Procedure**

| CONTROLS | FUNCTION AND DESCRIPTION |
|---|---|
| [◁] [▷] | Bright-Digit Editing |
| KNOB | Turn the edit knob to change the adjustment value. Use the left/right arrow keys to move the bright-digit within the adjustment field. The bright-digit is always located in the adjustment field. |
| [ON/OFF] | RF on/off<br><br>Toggles the RF output on/off. |
| [STATUS] | Overrange/uncal or Rejected Entry Status<br><br>Normally displays the overrange/uncal status. Displays the rejected entry status code if there is a rejected entry. |
| [STO] | Store Measured Data<br><br>Press once; the prompt "Sto ?" is displayed.<br><br>Press again to store the data. The message "-- Sto --" is displayed to confirm the selection. The updated calibration factor is stored in the calibration memory, and the last valid instrument state is restored.<br><br>Press any other key to cancel the store operation and resume the procedure. |
| [CLR\|LCL] | Abort the Cal Procedure<br><br>Press once; the prompt "Clr ?" is displayed.<br><br>Press again to abort the procedure. The message "-- Clr --" is displayed to confirm the selection. All measured data is discarded and the previous instrument state is restored.<br><br>Press any other key to resume the procedure. |

## 1-8. Remote AM Calibration Procedure

The following paragraphs describe the remote AM calibration procedure, the remote commands needed for this procedure, and the elements required to build a functioning controller program. Refer to the Remote Calibration, paragraph 1-3, for general information about remote calibration.

A sample controller program for the remote AM calibration procedure is contained in Appendix B. The program is written in Fluke BASIC and is provided as an example of the type of program that will run on a Fluke 1722A controller.

Table 1-2 provides information needed to create a remote calibration program. This table lists specific commands that must be included in the AM calibration program. Table 5B-3 in Section 5B of the Operator Manual describes the syntax of each command.

**Table 1-2. Remote Programming Commands for AM Calibration Procedure**

| COMMANDS | DESCRIPTION |
|---|---|
| CAL_AM | Initiate the remote AM calibration procedure |
| CC_RDAM | Send the mod meter reading to the 6080A |
| CC_FREQ? | Request the RF frequency |
| CC_TARGET? | Request the target value |
| RFOUT | Program the RF output on/off |
| CC_SAVE | Save the measured data |
| CC_EXIT | Abort the cal procedure immediately |
| ERROR? | Request the rejected entry status |
| STATUS/STATUS? | Load/Request the overrange/uncal status |

Figure 1-2 outlines the operation of the program in this procedure.

```
Initiate the AM calibration procedure with "CAL_AM"
Initialize modulation meter

MAIN_LOOP:
    Request the rf frequency with "CC_FREQ?"

    If( frequency = 9e9) goto DONE

    Read modulation meter
    Send reading to 6080A with "CC_RDAM"

    Goto MAIN_LOOP

DONE:
Store new data in calibration memory with "CC_SAVE"
END
```

**Figure 1-2. Basic Structure of the AM Calibration Program**

Proceed as follows to initiate the remote AM calibration procedure:

1. Set the rear panel CAL|COMP switch to 1 (on) position.

2. Initiate the bus controller program.

During the operation of the remote calibration procedure, the controller requests the signal generator's center frequency with the command CC_FREQ? and waits for a response.

When a response is received, the controller gets a modulation meter reading. The controller program ensures that each modulation meter reading is settled before sending the reading to the signal generator with the command CC_RDAM.

The signal generator receives the reading, adjusts its internal settings, and programs the new AM depth. The program continues to loop until the signal generator receives two consecutive readings within an error tolerance of 0.1%. At that point it considers the adjustment value correct and returns the end code "9E+09, HZ" to the controller in response to the CC_FREQ? command.

The controller then exits the main loop and saves the data with the CC_SAVE command.

## 1-9. FM CALIBRATION

This procedure calibrates allows a single point calibration (see listing below) of the FM deviation. The adjustment of the FM calibration factor is based on the reading of an rf modulation meter connected to the 6080A's rf output. The specific parameters for this procedure are listed below:

- Adjustment Range: +/- 10 kHz
- Adjustment Resolution: 0.1 kHz
- Target Value: 100 kHz
- Frequency: 640.000000 MHz
- RF Level: +10.0 dBm
- Internal FM: ON
- Modulation Frequency: 1 kHz
- External Equipment: RF Modulation Analyzer (HP 8901A or equivalent)

When performing the front panel procedure, use the edit knob to adjust the FM deviation until the measured deviation matches the target value. During the remote calibration procedure, a program running on an IEEE-488 bus controller directs the procedure.

Both the front panel and remote calibration procedures reconfigure the front panel display in the following ways: the target level displays in the modulation field, the rf frequency displays in the frequency field, the adjustment value displays in the amplitude field, and the CAL annunciator lights.

All adjustments update a temporary copy of the FM calibration factor. The copy in the calibration memory is updated only after the store command is given explicitly. After the store command has been given, the internal calibration factor is calculated from the displayed adjustment value and is stored in the calibration memory. Subsequent FM programming commands use the new calibration factor.

## 1-10. Front Panel FM Calibration Procedure

The display is reconfigured for the procedure. Several of the front panel controls are disabled or operate differently than they normally do. Table 1-1 lists the active front panel controls and describes their function during the calibration procedure.

Proceed with the following steps to execute the front panel FM calibration procedure:

1. Set the rear panel CAL|COMP switch to the 1 (on) position.

2. Enter special function 992 to initiate the FM procedure.

3. Connect the 6080A's rf output to the modulation meter.

4. Select the peak+ mode, enable the 50 Hz high-pass filter, and enable the 3 kHz low-pass filter on the modulation meter.

5. Use the edit knob to change the adjustment value until the modulation meter reads 100 kHz.

6. Press [STO] twice to store the new data.

## 1-11. Remote FM Calibration

The following paragraphs describe the remote FM calibration procedure, the remote commands needed for this procedure, and the elements required to build a functioning controller program. Refer to the Remote Calibration, paragraph 1-3, for general information about remote calibration.

A sample controller program for the remote FM calibration procedure is contained in Appendix B. The program is written in Fluke BASIC and is provided as an example of the type of program that will run on a Fluke 1722A controller.

Table 1-3 provides information needed to create a remote calibration program. This table lists specific commands that must be included in the FM calibration program. Table 5B-3 in Section 5B of the Operator Manual describes the syntax of each command.

**Table 1-3. Remote Programming Commands for FM Calibration Procedure**

| COMMANDS | DESCRIPTION |
|---|---|
| CAL_FM | Initiate the remote FM calibration procedure |
| CC_RDFM | Send the mod meter reading to the 6080A |
| CC_FREQ? | Request the RF frequency |
| CC_TARGET? | Request the target value |
| RFOUT | Program the RF output on/off |
| CC_SAVE | Save the measured data |
| CC_EXIT | Abort the cal procedure immediately |
| ERROR? | Request the rejected entry status |
| STATUS/STATUS? | Load/Request the overrange/uncal status |

Figure 1-3 outlines the operation of the program in this procedure.

```
Initiate the FM calibration procedure with "CAL_FM"
Initialize modulation meter

Main Loop
    Request the RF frequency with "CC_FREQ?"

    If( frequency = 9e9) goto DONE

    Read modulation meter
    Send reading to 6080A with "CC_RDFM"

    Goto Main Loop

DONE
Store new data in calibration memory with "CC_SAVE"
End
```

**Figure 1-3. Basic Structure of FM Calibration Program**

Proceed as follows to initiate the remote FM calibration procedure:

1. Set the rear panel CAL|COMP switch to 1 (on) position.

2. Initiate the bus controller program.

The bus controller initiates the procedure with the CAL_FM command. The controller requests the signal generator's center frequency with the CC_FREQ? command and waits for a response.

When a response is received, the controller gets a mod meter reading. The controller program ensures that each meter reading is settled before sending the reading to the signal generator with the command CC_RDFM.

Each time the signal generator receives a reading from the controller, it adjusts its internal settings and programs the new FM deviation.

The program remains in the main loop until the signal generator receives two consecutive readings within 0.1 kHz of the target value (100 kHz). At this time it considers the displayed adjustment value correct and returns the end code "9E+09, HZ" in response to the CC_FREQ? command.

The program then exits the main loop and the data is saved with the CC_SAVE command.

## 1-12. RF LEVEL CALIBRATION

The rf level calibration procedures perform a single-point calibration of the rf output level. An rf power meter is connected to the signal generator's rf output and the level calibration factor is adjusted based on the meter reading. The parameters specific to this procedure are as follows:

- Adjustment Range: +/- 1.00 dB
- Adjustment Resolution: 0.01 dB
- Target Value: 10.0 dBm
- Frequency: 300.000000 MHz
- RF Level: +10.0 dBm
- External Equipment: RF Power Meter (HP 436A or equivalent)

When performing the front panel procedure, use the edit knob to adjust the level until the measured level matches the target level. The remote calibration procedure is controlled by a program running on an IEEE-488 bus controller.

Both the front panel and remote calibration procedures reconfigure the front panel display in the following ways: the target level displays in the modulation field, the rf frequency displays in the frequency field, the adjustment value displays in the amplitude field, and the CAL annunciator lights.

All adjustments update a temporary copy of the adjustment value. The copy in the calibration memory is updated only after the store command is given explicitly. After the store command has been given, the internal calibration factor is calculated from the displayed adjustment value and is stored in the calibration memory. Subsequent amplitude programming commands use the new calibration factor.

### 1-13. Front Panel Level Calibration Procedure

The display is reconfigured for the procedure. Several of the front panel controls are disabled or operate differently than they normally do.

Table 1-1 (paragraph 1-7) lists the active front panel controls and describes the function of each.

Proceed as follows to execute the front panel level calibration procedure:

1. Set the rear panel CAL|COMP switch to the 1 (on) position.

2. Enter special function 993 to initiate the level calibration procedure.

3. Connect the signal generator's rf output to the power meter.

4. Set the appropriate power meter calibration factor (if required) and zero the power meter.

5. Use the edit knob to change the adjustment value until the power meter reads +10 dBm.

6. Press the [STO] key twice to store the new data.

## 1-14. Remote Level Calibration Procedure

The following paragraphs describe the remote level calibration procedure, the remote commands needed for this procedure, and the elements required to build a functioning controller program. Refer to the Remote Calibration, paragraph 1-3, for general information about remote calibration.

A sample controller program for the remote level calibration procedure is contained in Appendix B. The program is written in Fluke BASIC and is provided as an example of the type of program that will run on a Fluke 1722A controller.

Table 1-4 provides information needed to create a remote calibration program. This table lists specific commands that must be included in the level calibration program. Table 5B-3 in Section 5B of the Operator Manual describes the syntax of each command.

**Table 1-4. Remote Programming Commands for Level Calibration Procedure**

| COMMANDS | DESCRIPTION |
|---|---|
| CAL_LEVEL | Initiate the remote level calibration procedure |
| CC_RDPOWER | Send the power meter reading to the 6080A |
| CC_FREQ? | Request the RF frequency |
| CC_TARGET? | Request the target value |
| RFOUT | Program the RF output on/off |
| CC_SAVE | Save the measured data |
| CC_EXIT | Abort the cal procedure immediately |
| ERROR? | Request the rejected entry status |
| STATUS/STATUS? | Load/Request the overrange/uncal status |

Figure 1-4 outlines the operation of the program in this procedure.

```
Initiate the level calibration procedure with "CAL_LEVEL"
Initialize power meter

Main Loop
    Request the RF frequency with "CC_FREQ?"

    If( frequency = 9e9) goto DONE

    Read power meter
    Send reading to 6080A with "CC_RDOWER"

    Goto Main Loop

DONE
Store new data in calibration memory with "CC_SAVE"
End
```

**Figure 1-4. Basic Structure of Level Calibration Program**

Proceed as follows to initiate the remote level calibration procedure:

1. Set the rear panel CAL|COMP switch to 1 (on) position.

2. Initiate the bus controller program.

The bus controller initiates the procedure with the CAL_LEVEL command. The controller requests the signal generator's center frequency with the CC_FREQ? command and waits for a response.

When a response is received, the controller gets a power meter reading and sends it to the signal generator with the CC_RDPOWER command. The controller program ensures that each reading is settled before sending it to the signal generator.

Each time the signal generator receives a reading from the controller, it adjusts its internal settings and programs the new level. The program remains in the main loop until the signal generator receives two consecutive readings within 0.01 dB of the target value (10.00 dBm). The signal generator then considers the displayed adjustment value correct and returns the end code "9E+09, HZ" in response to the CC_FREQ? command.

The program then exits the main loop and saves the data with the CC_SAVE command.

## 1-15. REFERENCE OSCILLATOR CALIBRATION

The reference oscillator calibration procedures perform a single-point calibration of the internal 10-MHz reference oscillator. A frequency counter is connected to the 6080A's rf output, and the reference oscillator calibration factor is adjusted based on the counter reading. The following lists the specific parameters of this procedure:

- o Adjustment Range: 256 counts (6 ppm minimum)
- o Adjustment Resolution: 1 count
- o Target Value: 100 MHz
- o RF Frequency: 100 MHz
- o External Equipment: Frequency Counter (Fluke 1953A or equivalent)

When performing the front panel procedure, use the edit knob to adjust the calibration factor until the measured frequency matches the target value. During the remote calibration procedure, a program running on an IEEE-488 bus controller directs the procedure.

Both the front panel and remote calibration procedures reconfigure the front panel display in the following ways: the target level displays in the modulation field, the rf frequency displays in the frequency field, the adjustment value displays in the amplitude field, and the CAL annunciator lights.

All adjustments update a temporary copy of the adjustment value. The copy in the calibration memory is only updated after the store command is given explicitly. After the store command has been given, the internal calibration factor is calculated from the displayed adjustment value and is stored in the calibration memory.

NOTE

This procedure can be used only to adjust the frequency of the internal reference oscillator. It cannot be used to adjust the frequency of the optional high-stability or medium-stability references.

### 1-16. Front Panel Reference Oscillator Calibration Procedure

The display is reconfigured for the procedure. Several of the front panel controls are disabled or operate differently than they normally do.

Table 1-1 (paragraph 1-7) lists the active front panel controls and describes the function of each.

Proceed as follows to execute the front panel reference oscillator calibration procedure:

1. Set the rear panel CAL|COMP switch to the 1 (on) position.

2. Enter special function 994 to initiate the oscillator calibration procedure.

3. Connect the 6080A's rf output to the FLUKE 1953A's FREQA input.

4. Select the FREQA input, 1 second gate time, and the continuous trigger mode.

5. Use the edit knob to change the adjustment value until the counter reads 100 MHz.

6. Press the [STO] key twice to store the new data.

## 1-17. Remote Reference Oscillator Calibration Procedure

The following paragraphs describe the remote reference oscillator calibration procedure, the remote commands needed for this procedure, and the elements required to build a functioning controller program. Refer to the Remote Calibration, paragraph 1-3, for general information about remote calibration.

A sample controller program for the remote reference oscillator calibration procedure is contained in Appendix B. The program is written in Fluke BASIC and is provided as an example of the type of program that will run on a Fluke 1722A controller.

Table 1-5 provides information needed to create a remote calibration program. This table lists specific commands that must be included in the reference oscillator calibration program. Table 5B-3 in Section 5B of the Operator Manual describes the syntax of each command.

**Table 1-5. Remote Programming Commands for Reference Oscillator**

| COMMANDS | DESCRIPTION |
|---|---|
| CAL_REFOSC | Initiate the remote reference oscillator calibration procedure |
| CC_RDFREQ | Send the counter reading to the 6080A |
| CC_FREQ? | Request the RF frequency |
| CC_TARGET? | Request the target value |
| RFOUT | Program the RF output on/off |
| CC_SAVE | Save the measured data |
| CC_EXIT | Abort the cal procedure immediately |
| ERROR? | Request the rejected entry status |
| STATUS/STATUS? | Load/Request the overrange/uncal status |

Figure 1-5 outlines the operation of the program in this procedure.

```
Initiate the reference oscillator calibration procedure with "CAL_REFOSC"
Initialize frequency counter

Main Loop
    Request the RF frequency with "CC_FREQ?"

    If( frequency = 9e9) goto DONE

    Read frequency counter
    Send reading to 6080A with "CC_RDFREQ"

    Goto Main Loop

DONE
Store new data in calibration memory with "CC_SAVE"
End
```

**Figure 1-5. Basic Structure of the Reference Oscillator**

Proceed as follows to initiate the remote reference oscillator calibration procedure:

1. Set the rear panel CAL|COMP switch to 1 (on) position.

2. Initiate the bus controller program.

The bus controller initiates the calibration procedure with the CAL_REFOSC command. The controller requests the center frequency of the signal generator with the CC_FREQ? command and waits for a response.

When a response is received, the controller gets a counter reading, ensures that the reading is settled, and sends it to the signal generator with the command CC_RDFREQ.

Each time the signal generator receives a reading from the controller, it adjusts its internal settings and programs the new reference oscillator DAC setting.

The program remains in the main loop until the signal generator receives two consecutive readings within 10 Hz of the target value (100 MHz). Then the signal generator considers the displayed adjustment value correct and returns the end code "9E+09, HZ" in response to the CC_FREQ? command.

The program exits the main loop and the saves the data with the CC_SAVE command.

SECTION 2
PERFORMANCE TESTS

## 2-1. INTRODUCTION

The information in Section 2 describes the performance tests for the key parameters of the 6080A Synthesized Signal Generator.

Instrument specifications are used as the performance standard. These closed-case performance tests may be used as:

- o An acceptance test upon receipt of the instrument.
- o An indication that repair and/or calibration is required.
- o A performance verification after completing repairs or calibration of the instrument.

Individual performance tests can also be used as troubleshooting aids.

Warm up the signal generator being tested or the UUT (unit under test) with all covers in place for at least 2 hours before beginning the performance tests.

Fluke recommends that calibration be performed at two year intervals.

## 2-2. TEST EQUIPMENT

Table 2-1 lists the recommended test equipment to use for the performance tests, adjustment procedures, and troubleshooting the signal generator. A two-turn loop is shown Figure 2-1.

Table 2-1. Recommended Test Equipment

| INSTRUMENT NAME | MINIMUM REQUIREMENT | MANUFACTURER DESIGNATION | NOTES 1 |
|---|---|---|---|
| DVM | 5 1/2-Digit, 0.3% DC-20 kHz | JF 8840A-09 | A,P |
| DMM | 3 1/2-Digit, 1% DC and 1 kHz | JF 8020B | A,P,T |
| RMS Voltmeter | 10 Hz to 20 MHz, low noise | JF 8922A | |
| Wideband Amplifier | > 25-dB gain, 0.4 to 1050 MHz NF < 9 dB. | HP 8447D-010 | P |
| RF Spectrum Analyzer | 0.1 to 1.7 GHz, 100 Hz BW | HP 8568A | P,T |
| Oscilloscope | Four-trace 300 MHz, 5-mV/Div | TEK 2465-11 | T,P |
| FET Probe | DC-900 MHz | TEK 6201 | T |
| 500-Ohm Probe | DC-3.5 GHz, 10X | TEK P6156 | T |
| RF Voltmeter | 0.01 to 700 MHz, 0.01 to 3V +/- 10% | HI RF 801 | T 2 |
| Frequency Counter | 0.1-1050 MHz; 10 Hz res; 0.1V | JF 7220A | A,P,T |
| Modulation Analyzer | Input: 0.15 to 1300 MHz, 0 to +20 dBm<br>AM: 10 to 90%, +/- 1%,<br>FM: 0.1 to 100 kHz dev +/- 1%<br>External LO capability | HP 8901A w/Option -003 | A,P,T |
| Distortion Analyzer | 1 to 10% rng, +/-1 dB, 0.4 and 1 kHz | HP 339B | A,P,T |
| Power Meter | Instrumentation accuracy < +/-1% | HP 436A | A,P,T |
| Power Sensor (High-Level) | -30 to 20 dBm; VSWR < 1.2 for 0.4 to 1 MHz, < 1.1 for 1 to 2000 MHz, < 1.3 for > 2000 MHz | HP 8482A | |
| Power Sensor (Low-Level) | -67 to -20 dBm; VSWR < 1.4 for 10 to 30 MHz < 1.15 for 30 to 2100 MHz | HP 8484A | |
| Attenuator, 60, 13 dB | 0.1 to 2100 MHz VSWR < 1.15 | Narda 777C | P 4 |
| LF Synthesized Signal Generator | 10 Hz to 11 MHz, 10 Hz steps, 1V peak, Spurs and Harm < -50 dB | JF 6011A | A,P |

Table 2-1. Recommended Test Equipment (cont)

| | | | |
|---|---|---|---|
| HF Synthesized Signal Generator (Low Residual) | 0.5 to 1024 MHz | JF 6080A | P,T |
| Dynamic Signal Analyzer | | HP 3561A | P |
| 3 dB Hybrid | 25 dB isolation .03-2.5 GHz | Anzac H-183-4 | P |
| 6 dB Resistive Combiner | dc to 2.5 GHz | Weinschel 1506A | P |
| Frequency Standard | House Standard, 10 MHz | --- | A,P |
| Test Cable | Dual pin to BNC | JF 732891 | A,T |
| Coaxial Adapter | 50-ohm, Type-N(m) to BNC(f) | JF Y9308 | A,P,T |
| Service Adapter | 50-ohm, Module output to SMA | JF 744177 | T |
| Two-Turn Loop | For leakage test (See Figure 2-1) | Homebuilt | P,T 3 |
| VSWR Bridge | 10 to 2000 MHz | Wiltron 60N50 | P |
| 50-Ohm Termination | Type-N | JF Y9317 | P |
| Coaxial Cable, 50 ohm | 3 ft, BNC both ends | Y9111 | A,P,T |
| Coaxial Cable, 50 ohm | 6 ft, BNC both ends | Y9112 | A,P,T |
| Electric Screwdriver | Set to 7 inch-pounds torque | Jergens-CL6500/CLT50 | A,T |
| Variable Power Supply | 0 to 30V dc | Lambda | T |
| Measuring Receiver Set | 10 to 1300 MHz | HP 8902A | P |
| Sensor Module | 0.1 to 2600 MHz | HP 11722A | P |
| Pulse Generator | 50-ns pulse width, 10-MHz repetition rate | HP 8012B | P |
| BNC Termination | 50 ohm | Midwest Microwave 2048M | P |
| Detector | 3-GHz bandwidth, 5-ns rise time | Krytar D101 | P |

Table 2-1. Recommended Test Equipment (cont)

| | | | |
|---|---|---|---|
| Phase Noise Measurement System | | HP 3048A | P |
| Tuning Tool | .025-inch square drive | Johanson #4192 | |

NOTES:

1. A = Adjustment; P = Performance Test; T = Troubleshooting.
2. Helper Instruments.
3. Two-Turn, 1-inch diameter loop made of #18 enamel wire soldered to a BNC connector.
4. VSWR verified and actual attenuation calibrated to +/- 0.2 dB by the operator at application frequencies.

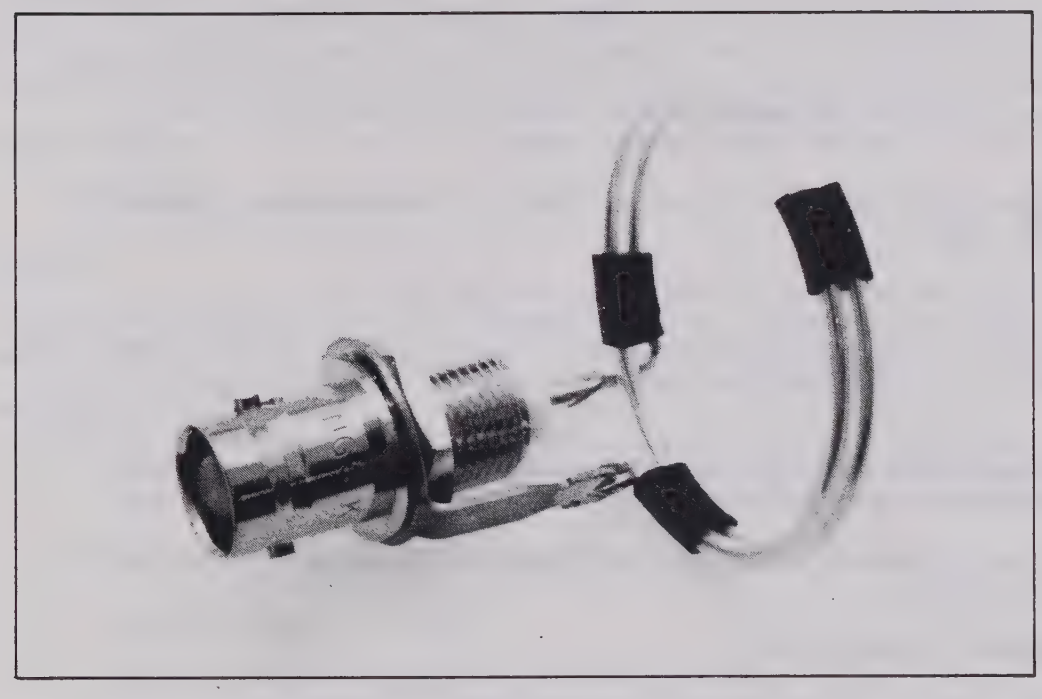

Figure 2-1. Two-Turn Loop

## 2-3. POWER-ON TEST

The functional checks of the instrument are performed by built-in self-tests.

REQUIREMENT:

The signal generator must successfully pass the self-test.

REMARKS:

Two self-test routines are available. One test is the normal power-on self-test (also invoked with SPCL 02), which does not allow rf power (not greater than -140 dBm) to be present at the output connector. The second test is a more complete, extended self-test (invoked with SPCL 06). This extended test does allow rf levels up to -20 dBm to be present at the output connector. The normal self-test begins each time the signal generator is turned on. Press any of the FUNCTION keys or the CRL/LCL key to abort the test.

PROCEDURE:

1. Start the test with the power off.

2. Press the POWER button on.

The signal generator automatically starts the self-tests. This 5 second test includes lighting all indicators and every segment of the display.

If the instrument fails any of the self-tests, failure codes appear in the four display fields. See Appendix E of the Operator Manual for the interpretation of the self-test status codes.

If the signal generator passes the self-test, it automatically returns to the default state.

3. Begin the extended self-test by entering SPCL 06.

The signal generator automatically starts the self-tests. This 5 second test includes lighting all indicators and every segment of the display.

If the instrument fails any of the self-tests, failure codes appear in the four display fields. See Appendix E of the Operator Manual for the interpretation of the self-test status codes.

If the signal generator passes the self-test, it automatically returns to the default state.

## 2-4. FREQUENCY ACCURACY TEST

The internal time base is compared to a frequency standard.

REQUIREMENTS:

The frequency of the UUT time base is within the specified limits.

TEST EQUIPMENT:

- Frequency standard
- Frequency counter

PROCEDURE:

1. Connect the frequency standard output to the 10 MHZ REF IN connector on the frequency counter and switch the counter to EXT REF.

2. Switch the UUT to internal reference.

3. Connect the UUT REF OUT connector to the frequency counter CHANNEL A input connector.

4. Verify that the counter displays 10 MHz +/-10 Hz.

## 2-5. SYNTHESIS TEST

A frequency counter operating on a common reference with the signal generator measures the output frequency of the signal generator at several programmed frequencies.

REQUIREMENT:

The signal generator's measured and programmed frequencies agree within +/-1 count.

TEST EQUIPMENT:

- o Frequency counter

REMARKS:

If the UUT fails this test, the frequency synthesis circuitry is probably at fault.

PROCEDURE:

1. Connect the UUT 10 MHz OUT to the frequency counter 10 MHz reference input, and connect the UUT rf output to the frequency counter input.
2. Set the UUT REF INT/EXT switch to INT.
3. Program the UUT to RCL 98.
4. Program the UUT frequency to 111.111111 MHz.
5. Program the UUT frequency step to 111.111111 MHz.
6. Verify that the reading on the frequency counter agrees with the UUT frequency +/-1 count as the frequency is stepped from 111.111111 to 999.999999 MHz.

## 2-6. HIGH-LEVEL ACCURACY TEST

The output power is measured using a power meter at various frequencies. First the step attenuator is set for zero attenuation, then each attenuator section is individually programmed. Finally, the output level accuracy and attenuator section errors are computed.

If a measuring receiver is available for level testing, proceed directly to the "ALTERNATE-LEVEL ACCURACY TEST" procedure in paragraph 2-9.

TEST EQUIPMENT:

- o Power meter
- o Power sensor (high-level)

REQUIREMENT:

The output level accuracy, the attenuator section errors, and the sum of the attenuator section errors at each test frequency are:

< +/-1.0 dB from 0.1 to 1056 MHz

REMARKS:

If the UUT fails this performance test, it requires calibration or repair. Possible problem areas (if no power-on status codes are present) include the A8 Output PCA, the A21 Attenuator PCA, or the A7 Relay Driver PCA.

The test frequencies of this procedure provide reasonable confidence of the amplitude accuracy of the UUT. However, additional test frequencies may be included in this test.

This test verifies the high-level accuracy of the signal generator and checks that the amplitude correction factors for the individual attenuator sections are correct. This test, in conjunction with the mid-level accuracy and low-level accuracy tests, verifies the overall level performance of the UUT.

NOTE

To test attenuator sections 4 through 7, program the 6080A Signal Generator to -12 dBm, and key in the following:

[SPCL] [9] [2] [3] through
[SPCL] [9] [2] [6], respectively.

PROCEDURE:

1. Calibrate and zero the power meter.

2. Program the UUT to RCL 98.

3. Connect the power sensor to the UUT rf output.

4. Program the UUT to the levels and frequencies as shown below and verify that the errors are less than +/-1 dB.

| LEVEL | FREQUENCY |
|---|---|
| +19 dBm | 0.1, 1, 5, 14, 20, 40, 80, 160, 320, 511.999999 MHz |
| +17 dBm | 512, 550, 640, 700, 850, 950, 1056 MHz |

5. Program the UUT frequency to 0.1 MHz and +12 dBm.

6. Select each attenuator section by programming the UUT amplitude to the levels shown in Table 2-2 and by using SPCL 923 through SPCL 926, and record the measured power at each level.

Table 2-2. High-Level Accuracy Test Conditions

| ATTENUATION | | OUTPUT POWER | | ERROR (dB) | SECTION ERROR (dB) | LIMIT (dB) |
|---|---|---|---|---|---|---|
| SECTION | NOMINAL | PROGRAMMED LEVEL (dBm) | MEASURED POWER (dBm) | | | |
| 0 | 0 | +12 | M0 | M0-12 | M0-12 | see test require-ments |
| 1 | 6 | +6 | M1 | M1-6 | -M0+M1+6 | |
| 2 | 12 | 0 | M2 | M2-0 | -M0+M2+12 | " |
| 3 | 24 | -12 | M3 | M3-12 | -M0+M3+24 | " |
| 4 | 24 | -12 | M4 | M4-12 | -M0+M4+24 | " |
| 5 | 24 | -12 | M5 | M5-12 | -M0+M5+24 | " |
| 6 | 24 | -12 | M6 | M6-12 | -M0+M6+24 | " |
| 7 | 24 | -12 | M7 | M7-12 | -M0+M7+24 | " |
| | | | | | Sum of Errors | " |

7. Compute the output power error for each programmed level of Table 2-2 by subtracting the programmed power in dBm from the measured power in dBm. These errors must not exceed the requirement stated above.

8. Subtract the measured power for section zero from the sum of the measured power for that section plus the nominal attenuation for that section. This is done for attenuator sections 1 through 7 only. (Example, (-M0+M1+6) for section 1.) The eight section errors and their sum must not exceed the requirement. Table 2-3 shows the parameters of the high-level accuracy test.

9. Repeat steps 4 through 7 with the UUT programmed to each of the following frequencies:

   1, 5, 14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, 1056 MHz

Table 2-3 is an example of this procedure in which the measured power and the error calculations are shown. This example is for one frequency, and these measurements and calculations are repeated at other frequencies. In this case, the section errors and the sum of the section errors are within the test limits; therefore, the unit passed the high-level accuracy test.

Table 2-3. High-Level Accuracy Test Conditions Sample

| ATTENUATION | | OUTPUT POWER | | ERROR (dB) | SECTION ERROR (dB) | LIMIT (dB) |
|---|---|---|---|---|---|---|
| SECTION | NOMINAL | PROGRAMMED LEVEL (dBm) | MEASURED POWER (dBm) | | | |
| 0 | 0 | +12 | +12.2 | +0.2 | +12.2-12.0 | = +0.2 |
| 1 | 6 | +6 | +05.9 | -0.1 | -12.2+5.9+6 | = +0.3 |
| 2 | 12 | 0 | -00.1 | -0.1 | -12.2-0.1+12 | = -0.3 |
| 3 | 24 | -12 | -12.1 | -0.1 | -12.2-12.1+24 | = -0.3 |
| 4 | 24 | -12 | -11.8 | +0.2 | -12.2-11.8+24 | = +0.0 |
| 5 | 24 | -12 | -12.0 | +0.0 | -12.2-12.0+24 | = -0.2 |
| 6 | 24 | -12 | -12.1 | -0.1 | -12.2-12.1+24 | = -0.3 |
| 7 | 24 | -12 | -11.9 | +0.1 | -12.2-11.9+24 | = -0.1 |
| | | | | | Sum of Errors | = -0.7 |

## 2-7. MID-LEVEL ACCURACY TEST

The level accuracy is verified using a power meter with a low-level power sensor. This verification is done from -24 to -66 dBm at frequencies of 10, 14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, and 1056 MHz.

REQUIREMENT:

Amplitude accuracy is:

< +/-1.0 dB from 10 to 1056 MHz

TEST EQUIPMENT:

- o Power meter
- o Power sensor (low-level)

REMARKS:

This test, in conjunction with the high-level accuracy test and the low-level accuracy test, verifies the overall level performance of the UUT.

If the UUT fails this test after passing the high level accuracy test, problems with the A21 Attenuator PCA or the A7 Relay Driver PCA are indicated.

Use the UUT RF OUTPUT ON/OFF control when zeroing the power meter.

PROCEDURE:

1. Program the UUT to RCL 98, 10 MHz, and -24 dBm.

2. Calibrate the power meter.

3. Zero the power meter.

4. Connect the power meter and power sensor to the UUT rf output.

5. Measure the UUT output power (in dBm) with the power meter. The output should agree with the programmed level in the requirement.

6. Repeat step 5 for levels of -30, -36, -42, -48, -54, -60, and -66 dBm.

7. Repeat steps 5 and 6 for frequencies of 14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, and 1056 MHz.

## 2-8. LOW-LEVEL ACCURACY TEST

An rf spectrum analyzer and amplifier are used to verify the UUT level accuracy at -127 dBm and -140 dBm at frequencies of 10, 14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, and 1056 MHz.

REQUIREMENT:

Amplitude accuracy is:
< +/-1.0 dB from 10 to 1056 MHz for levels to -127 dBm.
< +/-3.0 dB from 10 to 1056 MHz for levels between -127 dBm and -140 dBm.

TEST EQUIPMENT:

- o 0.1- to 1.1-GHz amplifier
- o 60-dB attenuator
- o 13-dB attenuator
- o RF spectrum analyzer
- o Power meter
- o Power sensor (low-level)

REMARKS:

This test, in conjunction with the mid-level accuracy and high-level accuracy test, verifies the overall level performance of the UUT.

If the UUT fails this test after passing the High-Level Accuracy Test and the Mid-Level Accuracy Test a problem in the A21 Attenuator PCA, the A7 Relay Driver PCA, or a leak-around problem in the attenuator assembly is indicated. Check for a broken feed-through filter or improper mechanical assembly, i.e., loose screws and/or damaged or misplaced gaskets.

Use the UUT RF OUTPUT ON/OFF control when zeroing the power meter.

PROCEDURE:

1. Program the UUT to RCL 98, 10 MHz, and -67 dBm.

2. Calibrate, then connect the power meter with a low-level power sensor to the UUT rf output.

3. Zero the power meter.

4. With the power meter, measure the UUT output power (in dBm) and record the measurement as the variable P.

5. Connect the UUT rf output through the 60-dB attenuator and connect the wideband amplifier to the input of the rf spectrum analyzer. Use well shielded cables to avoid leakage that could affect the measurement.

6. Adjust the rf spectrum analyzer to display the signal, using a resolution bandwidth of 1 kHz and a vertical display of 1 dB/Div.

7. Adjust the reference level so that the response is at a convenient reference point on the display (e.g., 2 dB below top scale). This signal response corresponds to a level of (P-A) dBm, where A is the value of the 60-dB attenuator.

8. Program the UUT to a level of -127 dBm, remove the 60-dB attenuator, and note the difference in the resulting response on the rf spectrum analyzer from the previous response (P-A). The actual UUT output level is (P-A) plus this difference and should agree with the programmed level to within the requirement.

9. Repeat steps 1 through 8 adding another 13-dB attenuator (total 73 dB) to the UUT rf output, and dial the signal generator level to -140 dBm. It may be necessary to reduce the spectrum analyzer resolution bandwidth.

10. Repeat steps 1 through 9 for frequencies of 14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, and 1056 MHz.

## 2-9. ALTERNATE-LEVEL ACCURACY TEST

A measuring receiver is used to verify the UUT level accuracy at various amplitude and frequency settings that test all level ranges of the UUT on all rf bands.

REQUIREMENTS:

Amplitude accuracy is:

<+/-1 dB from 0.1 to 511.999999 MHz from +19 to 0 dBm
<+/-1 dB from 512 to 1056 MHz from +17 to 0 dBm
<+/-1 dB from 2.5 to 1056 MHz from 0 to -127 dBm

TEST EQUIPMENT:

- o Measuring receiver
- o Sensor module

REMARKS:

This test is a more comprehensive test then the high-level, mid-level, and low-level accuracy tests.

If the UUT fails this test, the UUT must be calibrated or repaired.

If the UUT fails this test at higher levels, problems with the A8 Output PCA, the A21 Attenuator PCA, or the A7 Relay Driver PCA may be indicated.

If the UUT fails this test at lower levels, a problem with the A21 Attenuator PCA, the A7 Relay Driver PCA, or an rf-leakage problem with the attenuator assembly is probably indicated. Check for loose connectors, loose screws, improper gasketing, or a broken feed-through filter.

Because of operational subtleties in measuring receivers and with the intent of reducing the risk of measurement errors, the following procedure is written for use of the HP 8902A as the receiver.

NOTE

The calibration factors for the sensor module must be stored into the measuring receiver's "Cal Factor" table prior to performing calibrated rf power measurements. Correctly entered cal factors can be verified on the HP 8902A by using special functions 37.5 and 37.6. (Refer to the HP 8902A Owner's Manual.)

PROCEDURE (Level Measurements):

1. Perform the power meter "zero" and "self-calibration" for the measuring receiver. (Refer to the HP 8902A Owner's Manual.)

2. Connect all instruments as shown in Figure 2-2.

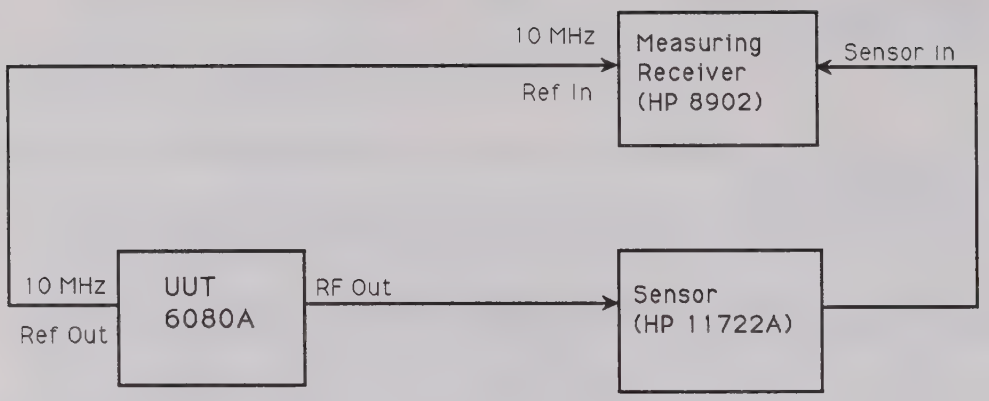


**Figure 2-2. Alternate-Level Accuracy Test Equipment Setup**

3. Program the UUT to RCL 98 then set levels and frequencies as below and verify that there are no errors greater than +/-1 dB.

| LEVEL | FREQUENCY |
|---|---|
| +19 dBm | 0.1, 1, 5, 14, 20, 40, 80, 160, 320, 511.999999 MHz |
| +13 dBm | same |
| +6.9 dBm | same |
| +0 dBm | same |
| +17 dBm | 512, 550, 640, 700, 850, 950, 1056 MHz |
| +13 dBm | same |
| +6.9 dBm | same |
| +0 dBm | same |

4. Program the UUT to RCL 98, 2.5 MHz, +0.8 dBm, and AMPL STEP 6.1 dB.

5. Program the measuring receiver to RF-POWER mode, and toggle the LOG/LIN button to display dBm. To enable the correct cal factor selection, tune the internal LO. on the measuring receiver to that of the UUT rf output (2.5 MHz for the first frequency).

6. Step the UUT level from +0.8 dBm to -11.4 dBm using the STEP [DOWN] key. Verify that each level measured with the measuring receiver agrees with the UUT programmed level and is within +/-1.0 dB.

7. Select TUNED-RF LEVEL on the measuring receiver, wait for a displayed reading, then press the CALIBRATE button. Verify that the Recal annunciator goes out and a stable reading is displayed again.

8. Step the UUT from -11.4 to -127.3 dBm, again observing that each stepped level is within +/-1.0 dB.

NOTE

When the Recal annunciator on the measuring receiver lights while stepping through UUT levels, press the CALIBRATE button on the measuring receiver and wait for a stable reading.

9. Repeat steps 5 through 8 for each of the following UUT frequencies:

   5, 14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, and 1056 MHz

## 2-10. FLATNESS TEST

A power meter and sensor are used to verify the high level flatness of the signal generator.

REQUIREMENT:

Amplifier flatness is:

< +/- 0.75 dB at +10 dBm over the frequency range of 0.1 to 1056 MHz.

TEST EQUIPMENT:

- o Power meter
- o Power sensor (high-level)

REMARKS:

If the UUT fails this test, calibration or repair is necessary. If no power-on status codes are present, likely problem areas needing repair include the A8 Output PCA, the A21 Attenuator PCA, or the A7 Relay Driver PCA.

PROCEDURE:

1. Calibrate and zero the power meter.
2. Connect the power sensor to the signal generator rf output.
3. Program the instrument to RCL 98 and then to 0.1 MHz and + 10 dBm.
4. The power meter should read + 10 +/-0.75 dBm.
5. Repeat step 4 for the following frequencies:

   a. 0.2 to 2.0 MHz in 0.1 MHz steps
   b. 2.0 to 20.0 MHz in 1.0 MHz steps
   c. 20.0 to 200.0 MHz in 10.0 MHz steps
   d. 200.0 to 1056.0 MHz in 20.0 MHz steps

## 2-11. OUTPUT LEAKAGE TEST

The output signal leakage is verified using a 1-inch diameter, two-turn loop. The induced signal is measured with an rf spectrum analyzer and compared to a 0.5-uV reference established at each reference frequency. The two-turn loop must be 1 inch away from any surface of the UUT.

REQUIREMENT:

Radiated emissions induce < 0.5 uV of the signal generator's output signal.

TEST EQUIPMENT:

- o 0.1- to 1050-MHz amplifier
- o RF spectrum analyzer
- o Two-turn loop
- o Type-N termination
- o Screen room, depending on the rf environment

REMARKS:

If the UUT fails this test, possible problems include a broken feed-through filter, or a damaged or misplaced mechanical assembly (i.e., loose screws, broken connection, etc.).

PROCEDURE:

1. Connect the UUT rf output to the wideband amplifier input, and connect the wideband amplifier output to the rf spectrum analyzer input. Use well shielded cables to avoid leakage that could affect the measurement.

2. Program the UUT to RCL 98.

3. Program the UUT to 9 MHz and -113 dBm. (0.5 uV).

4. Adjust the rf spectrum analyzer to display the UUT signal for a convenient reference. Make this adjustment using a vertical scale of 10 dB/division, a resolution bandwidth of 3 kHz, and a span/division of 5 kHz/division.

5. Disconnect the wideband amplifier from the UUT and terminate UUT output with the type-N termination.

6. Connect the two-turn loop to the wideband amplifier input.

7. Program the UUT to +13 dBm.

8. Verify that the leakage indicated by the rf spectrum analyzer is less than -113 dBm (0.5 uV) by moving the two-turn loop over the UUT surface at a distance of 1 inch.

9. Repeat steps 3 through 8 at 14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, and 1056 MHz.

## 2-12. HARMONIC AND LINE-RELATED SPURIOUS TEST

The Harmonic and Line-Related Spurious Test uses an rf spectrum analyzer to compare the level of the harmonic signal and close-in spurious signals to the desired signal at various programmed frequencies.

REQUIREMENTS:

- o RF harmonics: <-30 dBc for levels <= +13 dBm.
- o Power line spurious signals: -56 dBc (signals within 10 kHz of carrier)

TEST EQUIPMENT:

- o RF spectrum analyzer

PROCEDURE:

1. Connect the UUT rf output to the rf spectrum analyzer input.

2. Connect the rf spectrum analyzer 10 MHz output to the UUT 10 MHz input, and set the UUT to EXT REF.

3. Program the UUT to RCL 98.

4. Program the UUT to +13 dBm and 10 kHz.

5. Set the rf spectrum analyzer controls to display the UUT output signal and its harmonics (at least three harmonics wherever possible). Be careful not to overload the analyzer input. Overloading the rf spectrum analyzer causes it to generate harmonics, thus invalidating the test.

6. Verify that all the harmonics are more than 30 dB below the fundamental signal.

7. Verify that all the harmonics are more than 30 dB below the fundamental signal for the following frequencies:

   14, 20, 40, 80, 160, 320, 550, 640, 700, 850, 950, and 1056 MHz.

8. Set the rf spectrum analyzer to display the UUT output signal with a 2-kHz span and 10-Hz resolution. Verify that all spurious signals are below -56 dBc for frequencies listed in step 7.

9. Set the rf spectrum analyzer to display the UUT output signal with a 50-kHz span and 30-Hz resolution. Verify that all spurious signals are below -56 dBc for frequencies listed in step 7.

## 2-13. NON-HARMONIC SPURIOUS TEST USING RF SPECTRUM ANALYZER

REQUIREMENTS:

Non-harmonic spurious <-100 dBc for offsets greater than 500 kHz.

TEST EQUIPMENT:

- o RF spectrum analyzer

REMARKS:

An rf spectrum analyzer cannot be relied upon to make -100 dBc spurious measurements due to the analyzer's own internal spurious exceeding -100 dBc at a variety of rf frequencies. However, using the spectrum analyzer in a cohered narrow span, with the spectrum analyzer reference level set 20 dB off scale (causing the 50-dB reference line to be -70 dBc), a -110 dBc noise floor can be obtained allowing measurement of -100 dBc spurious signals at offsets greater than approximately 0.5 MHz from the carrier.

PROCEDURE:

1. Connect the UUT rf output to the rf spectrum analyzer input.
2. Connect the rf spectrum analyzer 10 MHz output to the UUT 10 MHz input. Set the UUT to EXT REF.
3. Program the UUT to [RCL] [9] [8].
4. Program the UUT to +16 dBm, 14.9 MHz.
5. Program the rf spectrum analyzer to 5.5 MHz, reference level to -14 dBm, span to 10 kHz. Verify the spurious signal in the center of the screen is greater than -100 dBc, which is greater than 80 dB down from the top of the screen.
6. Program the rf spectrum analyzer and UUT to the following frequencies, and verify the spurious signal in the center of the screen is greater than -100 dBc.

| UUT FREQUENCY (MHz) | RF SPECTRUM ANALYZER FREQUENCY (MHz) |
|---|---|
| 14.9 | 9.40 |
| 14.9 | 20.4 |
| 10.111111 | 10.999 |
| 11 | 13 |
| 11 | 20 |
| 11 | 80 |
| 11 | 91 |
| 527.91 | 528.54 |
| 536.11 | 536.66 |
| 538.76 | 539.32 |
| 540.65 | 541.20 |
| 542.08 | 542.72 |

| UUT FREQUENCY (MHz) | RF SPECTRUM ANALYZER FREQUENCY (MHz) (cont.) |
|---|---|
| 615.93 | 616.49 |
| 703.93 | 704.56 |
| 792.07 | 792.63 |
| 880.07 | 880.70 |
| 968.07 | 968.77 |
| 896.01 | 912.03 |
| 896.01 | 904.02 |
| 1024 | 936 |
| 1024 | 944 |
| 1024 | 1029 |

## 2-14. PHASE NOISE, RESIDUAL FM, AND SPURIOUS TEST USING PHASE NOISE TEST SET

Verify spurious signals (between 10 and 100 kHz offset) and phase noise by using a LO (HFSSG) and an rf mixer to cancel the carrier providing a zero difference beat frequency. Examine this frequency for spurious signals and phase noise on a low frequency dynamic signal analyzer.

REQUIREMENT:

The spurious signals are <-100 dBc for offsets greater than 10 kHz of the carrier.

**Table 2-4. Residual FM Requirements**

| APPROXIMATE CARRIER FREQUENCY BAND (MHz) | POST DETECTION BANDWIDTH | |
|---|---|---|
| | 0.3 kHz TO 3 kHz (CCITT) Hz RMS | 0.5 kHz TO 15 kHz Hz RMS |
| 512 to 1056 | 1.5 | 2.5 |
| 256 to 512 | 0.7 | 1.2 |
| .01 to 256 | 0.3 | 0.6 |

Table 2-5. Phase Noise Requirements

| APPROXIMATE CARRIER FREQUENCY BAND (MHz) | OFFSET FREQUENCY 1 kHz (dBc/Hz) | 20 kHz (dBc/Hz) | 100 kHz (dBc/Hz) |
|---|---|---|---|
| 512 to 1056 | -94 | -130 | -138 |
| 256 to 512 | -100 | -136 | -142 |
| 128 to 256 | -106 | -141 | -144 |
| 64 to 128 | -112 | -144 | -145 |
| 32 to 64 | -118 | -144 | -146 |
| 15 to 32 | -124 | -145 | -146 |
| .01 to 15 | -112 | -138 | -138 |

TEST EQUIPMENT:

- o HFSSG
- o Phase Noise Measurement System

PHASE NOISE AND NON-HARMONIC SPURIOUS TESTS

This method uses the HP 3048A Phase Noise Test Set and an additional 6080A signal generator to measure the phase noise and spurious signals. The phase noise is specified at a 20-kHz offset, and the spurious signals are specified for greater than a 10-kHz offset.

By using two presumably identical generators, the measured phase noise will be 3 dB higher than each individual generator, and the measured spurious signals could be as much as 6 dB higher than each individual generator. If the measured results are within specification, then both reference and UUT are within specification individually. If the measured results are out of specification, it is difficult to determine whether the reference or the UUT is out of specification without using a third 6080A. Alternatively, by using a reference generator with much better specified phase noise than the 6080A, the ambiguity can be reduced.

It is assumed that the user is familiar with the operation of the HP 3048A Phase Noise Test Set. The following procedure outlines setting up the system and inputting the various test parameters. Refer to the HP 3048A manual (hereafter called "the HP manual") for more information.

EQUIPMENT:

- o HP 3048A Phase Noise Test Set
- o Fluke 6080A Synthesized Signal Generator (or an equivalent generator)

PROCEDURE:

1. Configure the system as described in Appendix A of the HP manual.

2. Load the system software as described on pages A-10 through A-11 of the HP manual. The screen should show HP3048A PHASE NOISE SYSTEM MAIN SOFTWARE LEVEL. This screen will subsequently be referred to as the main menu.

3. Connect the equipment as shown in Figure 2-3.

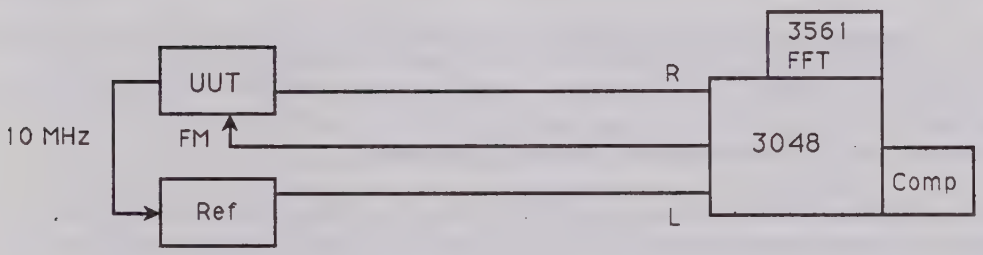


**Figure 2-3. Phase Noise And Non-Harmonic Spurious Tests Connection Diagram**

4. Set the reference 6080A (L input) to 1056 MHz, +17 dBm, external reference.

5. Set the UUT 6080A (R input) as follows:

   a. Frequency 1056 MHz
   b. Amplitude +10 dBm
   c. FM 2 kHz
   d. EXT DC FM

NOTE

Warm up both the UUT and reference 6080A for at least 2 hours.

6. Select System Config. Menu. Using the Delete Instr. softkey, delete all instruments except the FFT ANALYZER and INTERFACE. Return to the main menu by selecting DONE. Be sure the address on the HP 3561 is the same as in this menu.

7. In the main menu select Define Msrmnt. In this menu, select Type/Range. It is not necessary to change any parameters, so select DONE.

8. Select Instr. Params. In this menu set the carrier frequency to 1.056E9 Hz, set Detector/Discr. set Input Frequency to 1.056E9 Hz, VCO Tuning Constant to 2000 Hz/V, Center Voltage of VCO Tuning Curve 0V, Voltage Tuning Range of VCO +/-2V, VCO Tune-port Input Resistance to 600 ohms. Phase Detector - Internal Phase Detector: 5 MHz to 1600 MHz. Select DONE to return to the Measurement Definition Menu.

9. Select Calibr Process. In this menu select Measure the Detector Constant, Compute from expected T. Constant, and The PLL Suppression WILL be verified by using the appropriate softkey. Select DONE to return to the Measurement Definition Menu.

10. Select Source Control. In this menu select DUT: USER'S SRCE SYSTEM CONTROL (then select CONTROL and this should change to DUT: USER'S SRCE MANUAL CONTROL), REF SOURCE: USER'S SRCE MANUAL CONTROL, TUNE VOLTAGE line to DUT, by using the appropriate softkey. Select DONE to return to the Measurement Definition Menu.

11. Select Define Graph. Change the title as appropriate. Select DONE to return to the Measurement Definition menu. Select DONE to return to the main menu.

12. To start the measurement, select New Msrmnt. Select Yes. Proceed to verify this is a new measurement. After the diagram of the setup appears on the screen, turn UUT DCFM off, then turn it on again, and select Proceed. The measurement is complete when a phase noise plot appears on the screen. To accurately measure the phase noise at 20-kHz offset, select Other Keys, then select Marker ON/OFF (which should turn marker on). Position the marker at 20 kHz using the knob on the keyboard. The phase noise should be less than -130 dBc/rHz assuming the reference and UUT 6080A are identical. All spurs >10 Hz offset should be less than -100 dBc. All spurs <10 kHz offset should be less than -56 dBc.

    Generate a spur list, as necessary, by selecting Computd Outputs, Spur List, List Spurs, Next Page.

    If you are not measuring residual FM or $\Phi m$, return to the main menu by selecting DONE three times.

    Repeat for output frequencies: 14, 31, 63, 127, 255, and 511 MHz.

12A. Residual FM or Φm is measured from the Computd Outputs Menu. If measuring residual FM or Φm after the Spur List, select DONE, then select Integr. Noise.

To measure residual FM per requirements, select Data Type Snu (f) and input Start Freq. 300 Hz, Stop Freq. 3000 Hz. Select Eval. Intgrl.

Repeat for Start Freq. 50 Hz, Stop Freq. 15E3 Hz. The residual FM should be per requirements. Repeat for output frequencies: 14, 31, 63, 127, 255, and 511 MHz.

## 2-15. RESIDUAL AM NOISE TEST

Use the HP 3048A Phase Noise Test Set and an additional am detector to measure the residual am noise. It is assumed that the user is familiar with the operation of the HP 3048A Phase Noise Test Set. The following procedure outlines setting up the system and inputting the various test parameters. Refer to the HP 3048A manual ("the HP manual") for more information.

REQUIREMENT:

Residual am: <0.01% of 0.05- to 15-kHz post detection bandwidth.

TEST EQUIPMENT:

- o HP 3048A Phase Noise Test Set
- o HP 8472 AM Detector, Polarity Negative (or equivalent)
- o Narda 4780-3, 3-dB pad (or equivalent)
- o 300 uF, 6V (or greater), tantalum electrolytic capacitor
- o 1000 ohm, 1%, 1/8 W, metal film resistor

PROCEDURE:

1. Configure the system as described in Appendix A of the HP manual.

2. Load the system software as described on pages A-10 through A-11 of the HP manual. The screen should show HP3048A PHASE NOISE SYSTEM MAIN SOFTWARE LEVEL (main menu).

3. Connect the equipment as shown in Figure 2-4.

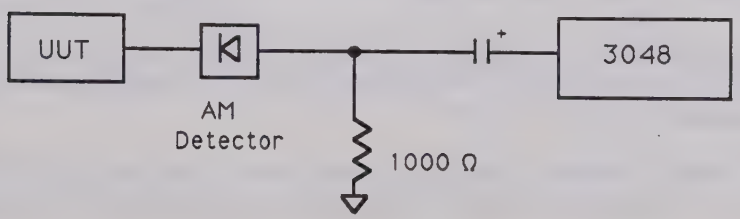


**Figure 2-4. Residual AM Noise Test Connection Diagram**

4. Set the UUT 6080A as follows:

   a. Frequency 1056 MHz
   b. Amplitude +7 dBm

NOTE

Warm up both the UUT and reference 6080A for at least 2 hours.

5. Select System Config. Menu. In this menu delete all instruments except the FFT ANALYZER and INTERFACE. Return to the main menu by selecting DONE. Be sure the address on the HP 3561 is the same as in this menu.

6. In the main menu select Define Msemnt. In this menu select Type/Range. Select AM Noise using Next Type softkey. Return to Measurement Definition Menu by selecting DONE.

7. Select Instr. Params. In this menu set carrier frequency 1.056E9 Hz, Detector/Discr. Set Input Frequency to 1.056E9 Hz. Use Select Detect to select External Phase/AM Detector. softkey. Select DONE to return to the Measurement Definition Menu.

8. Select Calibr Process. In this menu Use Next Method softkey to select Derive From Double Sided Spur. Enter Amplitude -40 dBc, Frequency 10E3 Hz. Select DONE to return to the Measurement Definition Menu.

9. Select Source Control. In this menu, use appropriate softkey to select DUT: USER'S SRCE MANUAL CONTROL, AM DETECTOR USER'S DEV. MANUAL CONTRL., and CAL SOURCE USER'S SRCE MANUAL CONTRL. Select DONE to return to the Measurement Definition Menu.

10. Select Define Graph. Change the title as appropriate. Selecting DONE to return to the Measurement Definition Menu. Select DONE to return to the main menu.

11. To start the measurement, select New Msrmnt. Select Yes, Proceed to verify this is a new measurement. After the diagram of the test setup appears on the screen, select Proceed.

    When instructed to Apply Calibration spur to carrier, set the UUT to AM 2%, MOD FREQ 10 kHz, and INT AM.

    When instructed to Remove calibration spur, press INT AM on the UUT (this turns off internal am). The measurement is complete when a noise plot appears on the screen.

    Select Other Keys, Computd Outputs, then Integr. Noise. Data Type should be L (f). Enter 50 Hz for Start Freq. and 15E3 Hz for Stop Freq.

    Select Eval Intgrl. The noise should be less than -80 dBc (.01%).

Select DONE three times to return to the main menu.

12. Change UUT to 14 MHz. Select Define Msrmnt, then Instr. Params. Change both Carrier Frequency and Detector/Discr. Input Frequency to 14E6. Return to main menu.

13. To start the measurement select New Msrmnt. When instructed to Apply calibration spur to carrier, set the UUT to AM 2%, MOD FREQ 10 kHz, and INT AM.

    When instructed to Remove calibration spur, press INT AM on the UUT (this turns off internal AM). The measurement is complete when a noise plot appears on the screen.

    Select Other Keys, Computd Outputs, the Integr. Noise. Data Type should be L(f).

    Enter 50 Hz for Start Freq. and 15E3 Hz for Stop Freq. Now select Eval Intgrl. The noise should be less than -80 dBc (.01%).

## 2-16. MODULATION TESTS

The following tests use a modulation analyzer to verify modulation accuracy and incidental modulation of the UUT. The modulation distortion is verified by measuring the demodulated output of the modulation analyzer with a distortion analyzer. The internal modulation oscillator frequency is measured using a frequency counter on the modulation output. The internal modulation oscillator amplitude is measured using an rms voltmeter.

## 2-17. Amplitude Modulation Tests

REMARKS:

If the UUT fails these performance tests, calibrate and/or repair the associated circuitry.

The UUT settings in this procedure are chosen to provide strong confidence in the modulation performance of the UUT throughout its range. If desired, however, performance may also be checked at other instrument settings.

TEST EQUIPMENT:

- Modulation analyzer
- Distortion analyzer
- Low-frequency synthesized signal generator (LFSSG)
- High-frequency synthesized signal generator (HFSSG)
- DVM

REQUIREMENTS:

AM Accuracy: +/-(2% + 4% of setting), up to 90% depth, 1-kHz rate.

AM Distortion at 1-kHz rate: <1.5%, 0-30% depth, <3%, 30-70% depth, <5%, 70-90% depth.

AM 3 dB Bandwidth: 20 Hz to 50 kHz, ac coupled, dc-50 kHz, dc coupled.

Incidental Phase Modulation: <0.2 rad at 30% AM and 1 kHz rate.

NOTE

The following procedures must be performed in the order given to ensure that the proper equipment is connected and the appropriate programs are enabled.

PROCEDURE (Internal AM Accuracy Test):

1. Program the UUT to: RCL 98, 90% Internal am, 1 kHz rate, +10 dBm level.

2. Program the Modulation Analyzer to measure AM depth in a 0.05 to 15-kHz bandwidth.

3. Measure the mean AM depth, (+PEAK plus -PEAK)/2, using the modulation analyzer.

4. Verify that the mean AM depth is between 84.4 and 95.6%.

PROCEDURE (AM Accuracy and Distortion Test):

1. Connect the LFSSG output to the UUT MOD INPUT connector and the DVM (use a BNC T connector).

2. Program the UUT for a frequency of 0.2 MHz, +10 dBm level, and EXT AM at 30% AM depth.

3. Program the LFSSG for 1 kHz at 0.7071V rms as measured by the DVM.

4. Connect the modulation output of the modulation analyzer to the input of the distortion analyzer.

5. Set the distortion analyzer to measure the THD of the 1-kHz modulation signal.

6. Verify that the mean AM depth (+PEAK plus -PEAK)/2 is between 25.5 and 34.5%.

7. Verify that the THD is less than 3%.

8. Program the remaining combinations of rf frequency, level, and am depth listed in Table 2-6. Verify that the accuracy and distortion requirements are met.

9. Repeat step 8 at a level of +4 dBm.

Table 2-6. AM Test Conditions

| FREQUENCY (MHz) | LEVEL (dBm) | AM (%) |
|---|---|---|
| 1056 | 0 | 30 |
| | | 50 |
| | | 90 |
| 950 | 0 | 30 |
| | | 50 |
| | | 90 |
| 700 | 0 | 30 |
| | | 50 |
| | | 90 |
| 640 | 0 | 30 |
| | | 50 |
| | | 90 |
| 550 | 0 | 30 |
| | | 50 |
| | | 90 |
| 320 | 0 | 30 |
| | | 50 |
| | | 90 |
| 160 | 0 | 30 |
| | | 50 |
| | | 90 |
| 80 | 0 | 30 |
| | | 50 |
| | | 90 |
| 40 | 0 | 30 |
| | | 50 |
| | | 90 |
| 20 | 0 | 30 |
| | | 50 |
| | | 90 |
| 14 | 0 | 30 |
| | | 50 |
| | | 90 |

PROCEDURE (AM Bandwidth Test):

1. Program the UUT for 50% INT AM at 1 kHz rate at 100 MHz, and +10 dBm.

2. With the modulation analyzer reading AM%, press the RATIO DB key to normalize the reading to 0.0 dB.

3. Set the modulation frequency to 50 kHz and read the change in level in AM in dB. Verify that the reading is greater than -3.0 dB.

4. Repeat steps 1 through 3 at 14, 20, 30, 40, 60, 80, 160, 250, 320, 400, 550, 640, 700, 850, 950, and 1056 MHz.

5. Repeat steps 1 through 4 at +4 dBm.

PROCEDURE (Incidental Phase Modulation Test):

1. Program the UUT for 30% INT AM at 1 kHz, at 640 MHz, and +10 dBm.

2. Program the modulation analyzer to measure peak phase deviation in a 0.3- to 3-kHz bandwidth. Connect the HFSSG to the external Local Oscillator input.

3. Verify that the incidental phase modulation is less than 0.2 rad.

NOTE

It may be necessary to compensate for residual noise effects using the procedure presented in the manual provided with the Modulation Analyzer.

4. Repeat step 3 at frequencies of 320, 160, 80, 40, 20, and 14 MHz.

## 2-18. Frequency Modulation Tests

REMARKS:

If the UUT fails these performance tests, calibrate and/or repair the associated circuitry.

The UUT settings in this procedure are chosen to provide strong confidence in the modulation performance of the UUT throughout its range. If desired, however, performance may also be checked at other instrument settings.

TEST EQUIPMENT:

- Modulation analyzer
- Distortion analyzer

REQUIREMENTS:

FM Accuracy: +/-(5% of setting +10Hz) for rates from 50 Hz to 50 kHz.

FM Distortion:

Standard Mode: <2% for 0.5 to 1.0 times maximum deviation; <1% for <0.5 times maximum deviation. Applies for rates of 50 Hz to 50 kHz.

Low Distortion Mode: <0.33% for < or = 3.5 kHz peak deviation and rates 0.3 to 3 kHz.

FM 3 dBm Bandwidth:

**Table 2-7. FM 3 dB Bandwidth**

| DEVIATION | COUPLING | |
|---|---|---|
| | INTERNAL AC | EXTERNAL AC (DC) |
| 0% to 25% Maximum | 20 Hz to 175 kHz | 20 Hz to 175 kHz |
| 25% to 100% Maximum | 20 Hz to 100 kHz | 20 Hz (ac) to 100 kHz |

Incidental AM: <1% depth for deviation <100 kHz at 1 kHz rate and carrier frequency >0.5 MHz.

PROCEDURE (FM Accuracy and Distortion Test):

1. Connect the modulation analyzer to the UUT rf output.
2. Program the modulation analyzer to measure peak FM in a 0.3- to 3-kHz bandwidth.
3. Program the UUT frequency to 640 MHz, +7 dBm, 20-kHz deviation, INT FM and 1-kHz modulation rate.
4. Set the distortion analyzer to measure distortion at 1 kHz.
5. Verify that the modulation analyzer reading is between 19 and 21 kHz, and that the THD is less than 1%. Repeat at deviations of 5 and 10 kHz. Verify that the modulation analyzer reading is within +/- 5% of the programmed value.
6. Program the UUT to a deviation of 50, 100, and 200 kHz.
7. Verify that the modulation analyzer reading and distortion is per the requirements.

NOTE

Change the modulation analyzer bandwidth and distortion analyzer frequency appropriately for modulation frequency for steps 8 through 16.

8. Repeat steps 4 through 7 with the modulation rate set to 100 Hz. Verify distortion only.

9. Repeat steps 4 through 7 with the modulation rate set to 50 kHz. Verify distortion only.

10. Program UUT to 40-MHz frequency, 25-kHz deviation, and 1-kHz INT modulation frequency.

11. Verify that the modulation analyzer reading and distortion is per the requirements.

12. Program the UUT to deviation of 50, 100, 200, and 250 kHz.

13. Verify that the modulation analyzer readings and distortion is per the requirements.

14. Repeat steps 10 through 13 with the modulation rate set to 100 Hz. Verify distortion only.

15. Repeat steps 10 through 13 with the modulation rate set to 50 kHz. Verify distortion only.

NOTE

It may be necessary to compensate for residual noise effects using the procedure presented in the manual provided with the Modulation Analyzer.

PROCEDURE (Incidental AM Test):

1. Program the UUT for 100-kHz deviation, INT FM on at 1 kHz, EXT FM off, a level of +7 dBm, and a frequency of 14 MHz.

2. Program the modulation analyzer to measure peak AM in a 0.3- to 3-kHz bandwidth.

3. Verify that the incidental AM is less than 1%.

4. Repeat steps 1 through 3 at frequencies of 20, 30, 40, 60, 80, 100, 160, 250, 320, 400, 550, 640, 700, 850, 950, and 1056 MHz.

PROCEDURE (FM Bandwidth Test):

1. Program the UUT to 14 MHz, +7 dBm, 1 kHz Mod Rate, INT FM, and 25% of Max Dev (125 kHz at 14 MHz).

2. Set modulation analyzer low low-pass filtering to all off, read FM Peak+, press Ratio DB key (normalize reading to 0.00 dB).

3. Set the UUT modulation frequency to 175 kHz. Verify the modulation meter reading is greater than -3dB.

4. Repeat steps 1 through 3 for the following frequencies: 20, 40, 100, 200, 300, and 750 MHz.

5. Repeat steps 1 through 4 with the FM deviation set at the maximum for each frequency and the modulation rate set for 100 kHz.

## 2-19. Phase Modulation Tests

REMARKS:

If the UUT fails these performance tests, calibrate and/or repair the associated circuitry.

The UUT settings in this procedure are chosen to provide strong confidence in the modulation performance of the UUT throughout its range. If desired, however, performance may also be checked at other instrument settings.

TEST EQUIPMENT:

- o Modulation analyzer
- o Distortion analyzer

REQUIREMENTS:

Phase Modulation Accuracy: +/-(5% of setting + 0.1 radian) at 1-kHz rate.

Phase Modulation Distortion: <2% for 0.5 to 1.0 times maximum deviation; <1% for <0.5 times maximum deviation. Applies for 1-kHz rate in standard mode, and from 50 Hz to 50 kHz in high rate mode.

Phase Modulation 3 dB External Bandwidth:
Standard Mode: 20 Hz to 15 kHz ac coupled; dc to 15 kHz, dc coupled.
High rate mode: 20 Hz to 100 kHz, ac coupled; dc to 100 kHz, dc coupled.

Incidental AM: <1% depth for peak deviation <10 radians at 1-kHz rate and carrier frequency >0.5 MHz.

PROCEDURE (ΦM Accuracy and Distortion Test):

1. Connect the modulation analyzer to the UUT rf output.

2. Program the modulation analyzer to measure peak ΦM in a 0.3- to 3-kHz bandwidth.

3. Program the UUT frequency to 640 MHz, +7 dBm, 20 radians, INT ΦM and 1-kHz modulation rate.

4. Set the distortion analyzer to measure distortion at 1 kHz.

5. Verify that the modulation analyzer reading is between 19 and 21 radians, and that the THD is less than 1%. Repeat at deviations of 5 and 10 radians. Verify that the modulation analyzer reading is within +/-5% of programmed value. (See the following NOTE.)

NOTE

For steps 8 through 15, change the modulation analyzer bandwidth and distortion analyzer frequency appropriately for modulation frequency.

6. Program the UUT to deviation of 50, 100, and 200 radians.

7. Verify that the modulation analyzer reading and distortion is per the requirements.

8. Repeat steps 4 through 7 with the modulation rate set to 100 Hz. Verify distortion only.

9. Program UUT to 40-MHz frequency, 2.5 radians deviation and 1-kHz INT modulation frequency.

10. Verify that the modulation analyzer reading is between 2.375 and 2.625 and that the distortion is less than 5%.

11. Program the UUT to deviation of 5, 10, 20, and 25 radians.

12. Verify that the modulation analyzer readings and the distortion is per the requirements.

13. Repeat steps 9 through 12 with the modulation rate set to 100 Hz. Verify distortion only.

NOTE

It may be necessary to compensate for residual noise effects using the procedure presented in the manual provided with the modulation analyzer.

PROCEDURE (Incidental AM Test):

1. Program the UUT for 10 radians deviation, INT ΦM on, 1 kHz mod rate, EXT ΦM off, a level of +7 dBm, and a frequency of 14 MHz.

2. Program the modulation analyzer to measure peak AM in a 0.3- to 3-khz bandwidth.

3. Verify that the incidental AM is less than 1%.

4. Repeat steps 1 through 3 at frequencies of 20, 30, 40, 60, 80, 100, 160, 250, 320, 400, 550, 640, 700, 850, 950, and 1056 MHz.

PROCEDURE (ΦM Bandwidth Test):

1. Program the UUT to: 14MHz, +7 dBm, 1kHz mod rate, INT ΦM, and 25% of maximum deviation (12.5 radians at 14 MHz).

2. Set modulation analyzer low-pass filtering to all-off, read ΦM Peak+, press Ratio ΦM key (normalize reading to 0.00 dB).

3. Set the UUT modulation frequency to 15 kHz. Verify that the modulation meter reading is greater than -3 dB.

4. Repeat steps 1 through 3 for frequencies: 20, 40, 100, 200, 300, and 750 MHz.

## 2-20. Internal Modulation Oscillator Tests

REMARKS:

If the UUT fails these performance tests, calibrate and/or repair the associated circuitry.

The UUT settings in this procedure are chosen to provide strong confidence in the modulation performance of the UUT throughout its range. If desired, however, performance may also be checked at other instrument settings.

TEST EQUIPMENT:

- Oscilloscope
- Distortion analyzer
- Frequency counter
- RMS voltmeter

REQUIREMENTS:

Modulation Frequency Accuracy: same as reference +/-7 mHz.
Output Level Accuracy: +/-(4% +15 mV) for rates <100 kHz, sinusoidal waveform.
Sinusoidal Distortion: <0.15% for rates <20 kHz and level >0.2V pk.

PROCEDURE (Frequency):

1. Set the 6080A to internal AM modulation with 50% depth and 100 kHz rf frequency.

2. Set the modulation oscillator frequency to 10 kHz.

3. Use an oscilloscope to observe both the rf output signal and the modulation output signal on two channels.

   Trigger the oscilloscope with the source. Verify that the modulation envelope appears coherent with the modulation frequency. That is, the rf signal is clearly visible within the modulation envelope (synchronized with the modulation signal).

PROCEDURE (Distortion):

1. Connect a 600-ohm load to the modulation output connector of the 6080A.

2. Set the internal modulation oscillator to sine wave output at 2V peak and to the desired output frequency.

3. Connect the distortion analyzer, oscilloscope and rms voltmeter in parallel with the load resistor.

4. Connect the distortion analyzer to measure distortion with its low pass filter set to a frequency at least four times higher than the set modulation frequency.

5. Measure the distortion.

6. Repeat the above measurements for various modulation frequencies within the specified range.

PROCEDURE (Level):

1. Using the JF 8922A rms voltmeter with a 600 ohm termination, verify that the level of the modulation output is within the above specification.

2. Repeat the above for various frequencies and output level settings.

## 2-21. VOLTAGE STANDING-WAVE RATIO (VSWR) TESTS

The Voltage Standing-Wave ratio (vswr) tests use a vswr bridge and a spectrum analyzer to verify vswr of the UUT.

REQUIREMENTS:

The output vswr is less than 1.5:1 for output levels < +6 dBm; < 2.0:1 for levels above +6 dBm.

EQUIPMENT REQUIRED:

- o VSWR bridge
- o RF spectrum analyzer
- o High-frequency synthesized signal generator (FSSG)

REMARKS:

The UUT settings in this procedure are chosen to provide confidence in the vswr performance of the UUT throughout its range. However, performance also may be checked at other levels.

VSWR problems are most likely to involve the A8 Output PCA or the A21 Attenuator PCA.

NOTE

The following procedures must be performed in the order given to ensure that the proper equipment is connected and appropriate programs are enabled.

PROCEDURE (Low-Level Test):

1. Turn on the UUT and program it to RCL 98.
2. Program the UUT to 640 MHz at +6 dBm.
3. Press [SPCL] [5] [1] to select the fixed range special function on the UUT.
4. Use the EDIT function on the UUT to edit the amplitude to -30 dBm. Verify that the UNCAL annunciator lights.

NOTE

This procedure leaves the output attenuators set as they would be for a +6 dBm output level, but uses the electronic control to turn down the rf level coming out of the UUT.

5. Connect the UUT to the Device Under Test port of the vswr bridge.
6. Connect the rf spectrum analyzer to the RF OUT port of the vswr bridge.
7. Connect the HFSSG to the RF IN port of the vswr bridge.
8. Program the HFSSG to 10 MHz at +13 dBm.
9. Set the rf spectrum analyzer to display approximately 10 to 1056 MHz and set the reference level to +10 dBm.

10. Step the HFSSG from 10 to 1056 MHz in 10-MHz steps. Locate the frequency at which the reflected signal (displayed by the rf spectrum analyzer) is maximum and record this level. This is the point with the worst-case vswr.

11. Disconnect the UUT from the vswr bridge and record the new level.

12. Calculate the return loss (difference) between the two recorded levels. The difference must be at least 14 dB (14 dB of return loss = 1.5:1 vswr).

PROCEDURE (High-Level Test):

1. Program the UUT to +10 dBm.

2. Press [SPCL] [5] [1] to select the special function fixed range on the UUT.

3. Use the EDIT function on the UUT to edit the amplitude to -30 dBm.

4. Connect the UUT to the Device Under Test port of the vswr bridge.

5. Step the HFSSG from 10 to 1056 MHz in 10-MHz steps. Locate the frequency at which the reflected signal is maximum and record this level.

6. Disconnect the UUT from the vswr bridge and record the new level.

7. Calculate the return loss between the two recorded levels. The difference must be at least 9.5 dB (9.5 dB of return loss = 2.0:1 vswr).

## 2-22. PULSE TESTS

The Pulse Tests check the static and dynamic operation of pulse modulation.

REQUIREMENTS:

Proper pulse operation is tested by checking the following:

On/Off Ratio:

**Table 2-8. ON/OFF Ratio**

| MODEL | CARRIER FREQUENCY | |
|---|---|---|
| | < 100 MHz | > 100 MHz |
| 6080A | 60 dB | 40 dB |

Rise/Fall time: <15ns, 10% to 90%. Typically 7.5ns.
Output Level Accuracy: Within +/- 0.7 dB of CW accuracy for pulse widths >50 ns.

TEST EQUIPMENT:

- o RF spectrum analyzer
- o Pulse generator
- o Power meter
- o Power sensor (high-level)
- o 50-Ohm termination
- o Oscilloscope
- o Detector

NOTE

The following procedures must be performed in the order given to ensure that the proper equipment is connected and the appropriate programs are enabled.

PROCEDURE (Static Test):

1. Program the UUT to 1056 MHz and +10 dBm.
2. Connect a 50-ohm termination to the pulse modulation input connector.
3. Connect the UUT rf output to the rf spectrum analyzer input.
4. Set the rf spectrum analyzer controls to display the output of the UUT using a span of approximately 0.1 MHz to 1056 MHz.
5. Activate pulse modulation by pressing the External Pulse key on the UUT.
6. Observe the level change on the rf spectrum analyzer. The change should exceed 40 dB.
7. Deactivate external pulse by pressing the External Pulse key on the UUT, and repeat steps 4 through 6 for UUT frequencies of 950, 850, 700, 640, 550, 400, 320, 250, 160, and 100 MHz.
8. Repeat 6 and 7 for the following frequencies: 80, 60, 40, 30, 20, 14, 5, 1, and 0.1 MHz. The requirement is that the observed level change is greater than 60 dB.

PROCEDURE (Dynamic Test):

1. Program the UUT to 640 MHz, +10 dBm, and external pulse modulation.
2. Connect the pulse generator to the UUT pulse input connector.
3. Set the pulse generator to a repetition rate of 5 MHz, +3V pulse level, and roughly a 50% duty cycle.
4. Connect the output of the UUT to the detector.

5. Terminate the detector into 50 ohms at the oscilloscope input.

6. Set the time base of the oscilloscope to 10 nanoseconds (or smaller) per division.

7. Use the oscilloscope channel to invert the detector output signal.

8. Trigger the oscilloscope on this signal.

9. Set the variable position and gain on the oscilloscope so that the signal extends from 0% to 100% on the graticule.

10. Measure the rise/fall time from the 90% to the 10% coordinates.

11. Verify that the rise/fall time is < 15 nanoseconds.

PROCEDURE (Level Error Test):

1. Remove the UUT, and reconnect the pulse generator directly into the oscilloscope.

2. Set the pulse generator to 5-MHz repetition rate, +3V level, and 50% duty cycle.

3. Adjust the oscilloscope position and gain controls for easy full scale viewing.

4. Readjust the pulse duty cycle for exactly 50% as measured at the 1V level of the oscilloscope.

5. Remove the pulse generator from the oscilloscope, and reconnect it to the pulse input of the UUT.

6. Program the UUT to 100 MHz, +7dBm, and external pulse modulation.

7. Connect the UUT output to the rf spectrum analyzer input.

8. Set the rf spectrum analyzer to observe a three-line spectra on either side of the center line spectra. The center spectra may be verified by turning pulse modulation off. (Use a spectrum analyzer setting of 5 MHz./div span and 100kHz resolution bandwidth.)

9. Adjust the duty cycle of the pulse generator for exactly 50% duty cycle by nulling the second line from the center line (approximately 10-MHz offset). A null of at least -30 dBc should be established.

10. Replace the rf spectrum analyzer with the power meter, and set the power meter to the reference setting.

11. Turn the UUT pulse modulation off and note the meter reading. The difference between the meter reading and 3.01 dB is the pulse level error. This error should be less than 0.7 dB.

12. Repeat steps 6 through 11 for 500 and 1056 MHz.

## 2-23. INTERMODULATION TEST

REQUIREMENTS:

Third-Order Intermodulation: Applies with each signal level at +4 dBm into a resistive combiner.

**Table 2-9. Intermodulation Requirements**

| APPROXIMATE CARRIER FREQUENCY BAND (MHz) | SIGNAL SPACING | |
|---|---|---|
| | 1 kHz | 25 kHz |
| 512 to 1056 | -65 dBc | -70 dBc |
| 128 to 512 | -65 dBc | -75 dBc |
| .01 to 128 | -60 dBc | -80 dBc |

TEST EQUIPMENT:

- o RF spectrum analyzer
- o 3 dB hybrid
- o HF syn signal generator
- o 6 dB resistive combiner

REMARKS:

The first part of this test is necessary to verify that the spectrum analyzer has a low enough level of internally generated intermodulation deviation (IMD) to allow the UUT measurement to be valid.

### 2-23A. Equipment Verification

PROCEDURE:

1. Connect the UUT and the HFSSG to the spectrum analyzer through isolated ports of the 3 dB hybrid.

2. Connect the spectrum analyzer 10 MHz out to the UUT and HFSSG 10 MHz inputs and set the UUT and HFSSG to EXT REF.

3. Program the UUT to RCL 98, 50 MHz, and +4 dB.

4. Program the HFSSG to RCL 98, 50.025 MHz, and +4 dBm.

5. Set the starting spectrum analyzer settings as follows:

   a. RF attenuation 20 dB.
   b. Reference level 0 dBm.
   c. Center frequency 49.975 MHz.
   d. Frequency span 100 kHz.

6. Adjust the reference level to place the UUT signal at the top graticule of the display.

7. Place a marker on the IMD product at 49.975 MHz.

8. Increase the spectrum analyzer rf attenuation to 30 and then to 40 dB while observing the IMD product at the marker. It will be necessary to reduce the frequency span to 1 kHz or less and reduce both the resolution bandwidth and video bandwidth to 10 Hz.

9. The IMD product at 49.975 MHz should be down at least 90 dB from the UUT carrier level.

10. Repeat steps 3 through 9 at 500 and 1000 MHz. Measurement values should be at least -85 and -80 dBc respectively. If these values (from steps 9 and 10) cannot be realized, the measurements on the UUT will likely not be valid.

**2-23B. Intermodulation Distortion Test**

1. Connect the UUT and the HFSSG to the spectrum analyzer through the 6 dB resistive combiner.

2. Connect the spectrum analyzer 10 MHz out to the UUT and HFSSG 10-MHz inputs and set the UUT and HFSSG to EXT REF.

3. Program the UUT to RCL 98, 50 MHz, and +4 dBm.

4. Program the HFSSG to RCL 98, 50.025 MHz, and +4 dBm.

5. Set the starting spectrum analyzer settings as follows:

   a. 20 dB rf attenuation
   b. Reference level 0 dBm.
   c. Center frequency 49.975 MHz.
   d. Frequency span 100 kHz.

6. Adjust the reference level to place the UUT signal at the top graticule of the display.

7. Place a marker on the IMD product at 49.975 MHz.

8. Change the spectrum analyzer settings as follows:

   a. Frequency span 1 kHz.
   b. Resolution bandwidth 10 Hz.
   c. Video bandwidth 10 Hz.

9. The IMD product should be at least -80 dBc, per the requirements.

10. Repeat steps 3 through 9 at 500 and 1000 MHz. The measurements should be -75 and -70 dBc, respectively.

# Appendix A. Compensation Memory Status Codes

## Table A-1. Calibration/Compensation Data Checksum Status Codes

| STATUS CODE | DESCRIPTION |
|---|---|
| 401 | Atten data in battery RAM is bad |
| 402 | Coarsecomp data in battery RAM is bad |
| 403 | Coarsesteer data in battery RAM is bad |
| 404 | Output data in battery RAM is bad |
| 405 | Subsynth data in battery RAM is bad |
| 406 | Sumcomp data in battery RAM is bad |
| 407 | Sumsteer data in battery RAM is bad |
| 408 | AM cal data in battery RAM is bad |
| 409 | FM cal data in battery RAM is bad |
| 410 | Level cal data in battery RAM is bad |
| 411 | Ref cal data in battery RAM is bad |
| 421 | Atten data in EEPROM is bad |
| 422 | Coarsecomp data in EEPROM is bad |
| 423 | Coarsesteer data in EEPROM is bad |
| 424 | Output data in EEPROM is bad |
| 425 | Subsynth data in EEPROM is bad |
| 426 | Sumcomp data in EEPROM is bad |
| 427 | Sumsteer data in EEPROM is bad |
| 428 | AM cal data in EEPROM is bad |
| 429 | FM cal data in EEPROM is bad |
| 430 | Level cal data in EEPROM is bad |
| 431 | Ref cal data in EEPROM is bad |
| 441 | Atten data mismatch |
| 442 | Coarsecomp data mismatch |
| 443 | Coarsesteer data mismatch |
| 444 | Output data mismatch |
| 445 | Subsynth data mismatch |
| 446 | Sumcomp data mismatch |
| 447 | Sumsteer data mismatch |
| 448 | AM cal data mismatch |
| 449 | FM cal data mismatch |
| 450 | Level cal data mismatch |
| 451 | Ref cal data mismatch |

Table A-2. Calibration/Compensation Data Origin Status Codes

| STATUS CODE | DESCRIPTION |
|---|---|
| 501 | MEC Atten data |
| 502 | MEC Output data |
| 503 | MEC Subsynth data |
| 521 | User Atten data |
| 522 | User Coarsecomp data |
| 523 | User Coarsesteer data |
| 524 | User Output data |
| 525 | User Subsynth data |
| 526 | User Sumcomp data |
| 527 | User Sumsteer data |
| 528 | User AM cal data |
| 529 | User FM cal data |
| 530 | User Level cal data |
| 531 | User Ref cal data |
| 541 | Unknown Atten data |
| 542 | Unknown Coarsecomp data |
| 543 | Unknown Coarsesteer data |
| 544 | Unknown Output data |
| 545 | Unknown Subsynth data |
| 546 | Unknown Sumcomp data |
| 547 | Unknown Sumsteer data |
| 548 | Unknown AM cal data |
| 549 | Unknown FM cal data |
| 550 | Unknown Level cal data |
| 551 | Unknown Ref cal data |

## Appendix B. Example Calibration Controller Programs

Appendix B consists of eight figures. Each figure is a listing of a calibration program that will run on the Fluke 1722A Controller. These figures are listed below:

- Figure B-1. Example AM Calibration Control Program
- Figure B-2. Example FM Calibration Control Program
- Figure B-3. Example Level Calibration Control Program
- Figure B-4. Example Reference Calibration Control Program
- Figure B-5. Example Output/Attenuator Compensation and Level Cal Program
- Figure B-6. Example Sub-synthesizer Compensation
- Figure B-7. Example Coarse Loop Compensation
- Figure B-8. Example Sum Loop Compensation

Figure B-1. Example AM Calibration Control Program

```
5     ! Fluke 6080A Signal Generator AM calibration control program.
6     !    Runs on a Fluke 1722A controller.
7     !
8     ! The rear panel CAL|COMP switch must be set to 1 (on) before
9     !    running this program.
10    !
11    ! Disclaimer:
12    !
13    !    This program is provided "AS IS".  No indemnity or warranties
14    !    are provided, whether expressed or implied.  FLUKE specifically
15    !    disclaims the implied warranties or merchantability and fitness
16    !    for the purpose or use.  In no event shall FLUKE be liable for
17    !    any loss of data, use, profits or goodwill, or for special,
18    !    incidental, consequential or other similar damages.
19    !
40    !
70    INIT PORT 0%
80    A% = 2%                          ! IEEE-488 address of Signal Generator
90    AM% = 14%                        ! IEEE-488 address of Modulation Analyzer
100   PRINT @ A%,"*rst;*cls"           ! initialize Signal Generator
110   GOSUB 3000                       ! initialize Modulation Analyzer
120   !
130   PRINT @A%,"cal_am"              ! enter AM calibration procedure
140   PRINT @A%,"error? explain" \ INPUT @ A%,ST%,EM$
150   IF (ST% = 0) THEN GOTO 1000
160       PRINT "There is an error with the 6080A."
170       PRINT ST%,EM$
180       STOP
1000  !
1010  ! Main loop
1020  !
1030      ! get frequency, exit main loop on last frequency
1040      PRINT @ A%,"cc_freq?" \ INPUT @ A%,F,UN$
1050      IF (F = 9E9) GOTO 2000
1060      !
1140      ! get modulation analyzer reading
1150      GOSUB 4000                   ! reading -> RD
1160      !
1170      ! send modulation analyzer reading to 6080A
1180      PRINT @ A%,"cc_rdam";RD;"pct"
1190  GOTO 1000
2000  !
2010  ! Store results
2020  !
2030  PRINT @ A%,"cc_save"             ! save data in compensation memory
2040  WAIT 5000                        ! wait 5 seconds for store to complete
2050  PRINT @ A%,"error? explain" \ INPUT @ A%,ST%,EM$
2060  IF (ST% = 0) THEN GOTO 2100
2070      PRINT "The store operation failed."
```

Figure B-1. Example AM Calibration Control Program (cont)

```
2080     PRINT EM$
2090     STOP
2100 LOCAL
2110 END
3000 !
3010 ! Subroutine to initialize HP 8901 Modulation Analyzer
3020 !
3030     PRINT @ AM%,"AUM1TO"     ! Automatic operation, AM, Free Run
3040     PRINT @ AM%,"H1L1D1"     ! 50 Hz HP Filter on, 3 kHz LP on, Peak+
3050 RETURN
4000  !
4010  ! Subroutine to get readings from HP 8901 Modulation Analyzer
4020  ! Give the modulation analyzer 700 msec to settle.  Then get
4030  ! readings until two are within 0.1%.  Get one more reading
4035  ! and return the average of all three.
4040  !
4050  INPUT @ AM%,R1
4060  !
4070  WAIT 700
4100  INPUT @ AM%,RD
4110  IF ABS(RD-R1) <= 0.1 THEN GOTO 4200
4120  R1 = RD
4130  GOTO 4100
4200  R1 = RD + R1
4210  INPUT @ AM%,RD
4220  RD = (RD + R1)/3
4230  RETURN
```

Figure B-2. Example FM Calibration Control Program

```
5     ! Fluke 6080A Signal Generator FM calibration control program.
6     !    Runs on a Fluke 1722A controller.
7     !
8     ! The rear panel CAL|COMP switch must be set to 1 (on) before
9     !    running this program.
10    !
11    ! Disclaimer:
12    !
13    !    This program is provided "AS IS".  No indemnity or warranties
14    !    are provided, whether expressed or implied.  FLUKE specifically
15    !    disclaims the implied warranties or merchantability and fitness
16    !    for the purpose or use.  In no event shall FLUKE be liable for
17    !    any loss of data, use, profits or goodwill, or for special,
18    !    incidental, consequential or other similar damages.
19    !
40    !
50    ! Initialization
60    !
70    INIT PORT 0%
80    A% = 2%                          ! IEEE-488 address of Signal Generator
90    AM% = 14%                        ! IEEE-488 address of Modulation Analyzer
100   PRINT @ A%,"*rst;*cls"           ! initialize Signal Generator
110   GOSUB 3000                       ! initialize Modulation Analyzer
120   !
130   PRINT @ A%,"cal_fm"              ! enter FM calibration procedure
140   PRINT @ A%,"error? explain" \ INPUT @ A%,ST%,EM$
150   IF (ST% = 0) THEN GOTO 1000
160       PRINT "There is an error with the 6080A."
170       PRINT ST%,EM$
180       STOP
1000  !
1010  ! Main loop
1020  !
1030      ! get frequency, exit main loop on last frequency
1040      PRINT @ A%,"cc_freq?" \ INPUT @ A%,F,UN$
1050      IF (F = 9E9) GOTO 2000
1060      !
1140      ! get modulation analyzer reading
1150      GOSUB 4000                   ! reading -> RD
1160      !
1170      ! send modulation analyzer reading to 6080A
1180      PRINT @ A%,"cc_rdfm";RD;"hz"
1190  GOTO 1000
2000  !
2010  ! Store results
2020  !
2030  PRINT @ A%,"cc_save"             ! save data in compensation memory
2040  WAIT 5000                        ! wait 5 seconds for store to complete
2050  PRINT @ A%,"error? explain" \ INPUT @ A%,ST%,EX$
```

Figure B-2. Example FM Calibration Control Program (cont)

```
2060 IF (ST% = 0) THEN GOTO 2100
2070     PRINT "The store operation failed."
2080     PRINT ST%,EX$
2090     STOP
2100 LOCAL
2110 END

3000 !
3010 ! Subroutine to initialize HP 8901 Modulation Analyzer
3020 !
3030     PRINT @ AM%,"AUM2T0"      ! Automatic operation, FM, Free Run
3040     PRINT @ AM%,"H1L1D1"      ! 50 Hz HP Filter on, 3 kHz LP on, Peak+
3050 RETURN

4000  !
4010  ! Subroutine to get readings from HP 8901 Modulation Analyzer
4020  ! Give the modulation analyzer 700 msec to settle.  Then get
4030  ! readings until two are within 100 hz.  Get one more reading
4035  ! and return the average of all three.
4040  !
4050  INPUT @ AM%,R1
4060  !
4070  WAIT 700
4100    INPUT @ AM%,RD
4110    IF ABS(RD-R1) <= 100 THEN GOTO 4200
4120    R1 = RD
4130    GOTO 4100
4200  R1 = RD + R1
4210  INPUT @ AM%,RD
4220  RD = (RD + R1)/3
4230  RETURN
```

Figure B-3. Example Level Calibration Control Program

```
1     ! Fluke 6080A Signal Generator Level calibration control program.
2     !    Runs on a Fluke 1722A controller.
3     !
4     ! NOTE: enter the power meter calibration factors for your power
5     !    meter into the table in the subroutine beginning at line
6     !    7000.  Remember to specify the number of entries in the table.
7     !
8     ! The rear panel CAL|COMP switch must be set to 1 (on) before
9     !    running this program.
10    !
11    ! Disclaimer:
12    !
13    !    This program is provided "AS IS".  No indemnity or warranties
14    !    are provided, whether expressed or implied.  FLUKE specifically
15    !    disclaims the implied warranties or merchantability and fitness
16    !    for the purpose or use.  In no event shall FLUKE be liable for
17    !    any loss of data, use, profits or goodwill, or for special,
18    !    incidental, consequential or other similar damages.
19    !
40    !
50    INIT PORT 0
60    A% = 2%                          ! IEEE-488 address of Signal Generator
70    AP% = 13%                        ! IEEE-488 address of Power Meter
80    PRINT @ A%,"*rst;*cls"           ! initialize Signal Generator
90    GOSUB 3000                       ! initialize Power Meter
100   GOSUB 7000                       ! set up CAL factor tables
640   PRINT @ A%,"cal_level"
650   PRINT @ A%,"error? explain" \ INPUT @ A%,ST%,EM$
660   IF (ST% = 0 ) THEN GOTO 800
670       PRINT "There is an error with the 6080A."
680       PRINT ST%,EM$
690       STOP
800   !
810   GOSUB 5000                       ! zero power meter
1000  !
1010  ! Main loop
1020  !
1030      ! get frequency, exit main loop on last frequency
1040      PRINT @ A%,"cc_freq?" \ INPUT @ A%,F,UN$
1050      IF (F = 9E9) GOTO 2000
1060      !
1130      ! get power meter reading
1140      GOSUB 4000                   ! reading -> RD
1150      !
1160      ! send power meter reading to 6080A
1170      PRINT @ A%,"cc_rdpower";RD;"dbm"
1180  GOTO 1000
2000  !
2010  ! Store results
```

Figure B-3. Example Level Calibration Control Program (cont)

```
2020 !
2030 PRINT @ A%,"cc_save"          ! save data in compensation memory
2040 !
2050 PRINT @ A%,"error? explain" \ INPUT @ A%,ST%,EM$
2060 IF (ST% = 0) THEN GOTO 2900
2080     PRINT "The store operation failed."
2090     PRINT ST%,EM$
2100     STOP
2110 !
2900 LOCAL
2910 END
3000 !
3010 ! Subroutine to initialize HP 436A Power Meter
3020 ! P$ is used when zeroing the power meter too
3030 !
3040     P$ = "D+9H"           ! dBm mode, no CAL factor, auto range, Hold
3050     PRINT @ AP%,P$
3060     PRINT @ AP%,"I"       ! get first reading
3070     INPUT LINE @ AP%,RD$ ! throw it away
3080 RETURN
4000 !
4010 ! Subroutine to get readings from HP 436A Power Meter
4020 !
4030 ! Get two readings within .01 dB, then read eight
4040 !   more and return the average of all ten.
4050 !
4060     ! set delay to 200 ms or 400 ms if 24 dB pad
4070     WT% = 200%
4090     !
4100     ! wait 2 seconds
4110     WAIT 2000 \ PRINT @ AP%,"I" \ INPUT LINE @ AP%,RD$
4120     !
4130     R1 = VAL(RIGHT(RD$,4))
4480     !
4490     ! get settled reading
4500     !
4510         WAIT WT% \ PRINT @ AP%,"I" \ INPUT LINE @ AP%,RD$
4520         RD = VAL(RIGHT(RD$,4))
4530         IF ABS(RD-R1) <= .01 THEN GOTO 4600
4540         R1 = RD
4550     GOTO 4500
4580     !
4590     ! The reading is in the settled range, now average more.
4600     R1 = R1 + RD     ! sum includes last 2 readings
4605     AV = 10.0
4610     FOR I% = 1% TO (AV-2)
4620        PRINT @ AP%,"I" \ INPUT LINE @ AP%,RD$
4630        RD = VAL(RIGHT(RD$,4))
4640        R1 = R1 + RD
4650     NEXT I%
4660     RD = R1 / AV
4670     !
```

Figure B-3. Example Level Calibration Control Program (cont)

```
4800     GOSUB 6000                ! power meter CAL factor -> CF
4810     RD = RD + CF
4840 RETURN
5000 !
5010 ! Subroutine to zero HP 436A Power Meter
5020 ! P$ is set up in the power meter initialization routine
5030 !
5040     PRINT @ A%,"rfout off" \ WAIT 3000
5050     PRINT @ AP%,"Z1T" \ WAIT 30
5060     PRINT @ AP%,P$ \ WAIT 5000
5070     PRINT @ A%,"rfout on" \ WAIT 30
5080 RETURN
6000 !
6010 ! Subroutine to compute power meter CAL factor
6020 !
6030     ! use first data point if frequency is low
6040     CF = 10 * LOG(1/CA(1%))
6050     IF (F/1.0E6 <= FR(1%)) THEN RETURN
6060     !
6070     ! use last data point if frequency is high
6080     CF = 10 * LOG(1/CA(30%))
6090     IF (F/1.0E6) >= FR(30%) THEN RETURN
6100     !
6110     ! search table for closest frequency points
6120     I% = 1%
6130     IF (F/1.0E6 < FR(I%)) THEN GOTO 6500
6140     I% = I% + 1%
6150     GOTO 6130
6500     !
6510     ! interpolate between frequency points
6520     D = (F/1.0E6 - FR(I%-1%)) / (FR(I%)-FR(I%-1%))
6530     C = ( D * (CA(I%)-CA(I%-1%)) ) + CA(I%-1%)
6540     !
6550     ! convert ratio to dB
6560     CF = 10 * LOG(1/C)
6570 RETURN
7000 !
7010 ! Subroutine to set up CAL factor tables
7020 !
7030 ! Number of frequencies used - Maximum of 30
7040 DATA 11
7050 !
7060 ! Table of Frequencies in MHz, and CAL factors
7065 !    as multiplicative scale factors.
7066 !    (Nominally multiply by 1.00).
7070 DATA   .1, 1.00
7080 DATA   .3, 1.00
7090 DATA    1, 1.00
7100 DATA    3, 1.00
7110 DATA   10, 1.00
7120 DATA   30, 1.00
7130 DATA  100, 1.00
```

Figure B-3. Example Level Calibration Control Program (cont)

```
7140 DATA  300, 1.00
7150 DATA 1000, 1.00
7160 DATA 1700, 1.00
7170 DATA 2100, 1.00
7300 !
7310 DIM FR(30%), CA(30%)
7320 !
7330 READ N% \ IF (N% > 30%) THEN N% = 30%
7340 FOR I% = 1% TO N%
7350     READ FR(I%) ! load frequency table
7360     READ CA(I%) ! load CAL factor table
7370 NEXT I%
7380 !
7390 !
7400 FOR I% = N%+1% TO 30%
7410     FR(I%) = FR(N%) ! fill in rest of tables
7420     CA(I%) = CA(N%)
7430 NEXT I%
7440 RETURN
```

Figure B-4. Example Reference Calibration Control Program

```
5     ! Fluke 6080A Signal Generator Reference calibration control program.
6     !    Runs on a Fluke 1722A controller.
7     !
8     ! The rear panel CAL|COMP switch must be set to 1 (on) before
9     !    running this program.
10    !
11    ! Disclaimer:
12    !
13    !    This program is provided "AS IS".  No indemnity or warranties
14    !    are provided, whether expressed or implied.  FLUKE specifically
15    !    disclaims the implied warranties or merchantability and fitness
16    !    for the purpose or use.  In no event shall FLUKE be liable for
17    !    any loss of data, use, profits or goodwill, or for special,
18    !    incidental, consequential or other similar damages.
19    !
40    !
70    INIT PORT 0%
80    A% = 2%                          ! IEEE-488 address of Signal Generator
90    FC% = 20%                        ! IEEE-488 address of Frequency Counter
100   PRINT @ A%,"*rst;*cls"           ! initialize Signal Generator
110   GOSUB 3000                       ! initialize counter
112   !
120   !
130   PRINT @A%,"cal_refosc"           ! enter Reference Osc. Cal procedure
140   PRINT @A%,"error? explain" \ INPUT @ A%,ST%,EM$
150   IF (ST% = 0) THEN GOTO 1000
160       PRINT "There is an error with the 6080A."
170       PRINT ST%,EM$
180       STOP
1000  !
1010  ! Main loop
1020  !
1030      ! get frequency, exit main loop on last frequency
1040      PRINT @ A%,"cc_freq?" \ INPUT @ A%,F,UN$
1050      IF (F = 9E9) GOTO 2000
1060      !
1140      ! get counter reading
1150      GOSUB 4000                   ! reading -> RD
1160      !
1170      ! send modulation analyzer reading to 6080A
1180      PRINT @ A%, USING "##########", "cc_rdfreq";RD;"hz"
1190  GOTO 1000
2000  !
2010  ! Store results
2020  !
2030  PRINT @ A%,"cc_save"             ! save data in compensation memory
2040  WAIT 5000                        ! wait 5 seconds for store to complete
2050  PRINT @ A%,"error? explain" \ INPUT @ A%,ST%,EM$
2060  IF (ST% = 0) THEN GOTO 2900
```

Figure B-4. Example Reference Calibration Control Program (cont)

```
2070     PRINT "The store operation failed."
2080     PRINT EM$
2090     STOP
2900 LOCAL
2910 END

3000 !
3010 ! Subroutine to initialize Fluke 1953A Counter
3020 !   reset counter (input port A, trigger level 0 Volts
3030 !       positive slope AC coupled).
3040 !   select 1 second range and triggered mode
3050 !
3060     PRINT @ FC%,"C R4 H1"
3070 RETURN

4000  !
4010  ! Subroutine to get readings from Fluke 1953A Counter
4020  ! Give the counter 2 seconds to settle.  Then get
4030  ! readings until two are within 5 hz.  Get one more reading
4035  ! and return the average of all three.
4040  !
4050  PRINT @FC%,"T" \ WAIT 1000 \ INPUT @ FC%,R1
4060  !
4070  WAIT 2000
4100  PRINT @FC%,"T" \ WAIT 1000 \ INPUT @ FC%,RD
4110  IF ABS(RD-R1) <= 5 THEN GOTO 4200
4120  R1 = RD
4130  GOTO 4100
4200  R1 = RD + R1
4210  PRINT @FC%,"T" \ WAIT 1000 \ INPUT @ FC%,RD
4220  RD = (RD + R1)/3
4230  RETURN
```

Figure B-5. Example Output/Attenuator Compensation and Level Cal Program

```
1     ! Fluke 6080A Signal Generator Output/Attenuator compensation and
2     !    Level Cal control program. Runs on a Fluke 1722A controller.
3     !
4     ! NOTE: enter the power meter calibration factors for your power
5     !    meter into the table in the subroutine beginning at line
6     !    7000.  Remember to specify the number of entries in the table.
7     !
8     ! The rear panel CAL|COMP switch must be set to 1 (on) before
9     !    running this program.
10    !
11    ! Disclaimer:
12    !
13    !    This program is provided "AS IS".  No indemnity or warranties
14    !    are provided, whether expressed or implied.  FLUKE specifically
15    !    disclaims the implied warranties or merchantability and fitness
16    !    for the purpose or use.  In no event shall FLUKE be liable for
17    !    any loss of data, use, profits or goodwill, or for special,
18    !    incidental, consequential or other similar damages.
19    !
20    !
30    TIMEOUT 10000
50    INIT PORT 0
60    A% = 2%                          ! IEEE-488 address of Signal Generator
70    AP% = 13%                        ! IEEE-488 address of Power Meter
80    PRINT @ A%,"*rst;*cls"           ! initialize Signal Generator
90    GOSUB 3000                       ! initialize Power Meter
100   GOSUB 7000                       ! set up CAL factor tables
500   !
510   ! Ask operator which cal/comp procedure
520   !
530   MD% = 0%                         ! default level calibration
540   PRINT "Select calibration/compensation procedure:"
545   PRINT "    0 for level calibration"
550   PRINT "    1 for output compensation"
560   PRINT "    2 for attenuator compensation"
570   PRINT "    3 for output with default attenuator compensation"
580   INPUT MD%
590   IF (MD% < 0 OR MD% > 3%) GOTO 500
595   IF (MD% = 0%) THEN CM$ = "cal_level"
600   IF (MD% = 1%) THEN CM$ = "comp_out"
610   IF (MD% = 2%) THEN CM$ = "comp_att"
620   IF (MD% = 3%) THEN CM$ = "comp_outdef"
630   !
640   PRINT @A%,CM$
650   PRINT @ A%,"error? explain" \ INPUT @ A%,ST%,EM$
660   IF (ST% = 0 ) THEN GOTO 800
670       PRINT "There is an error with the 6080A."
680       PRINT ST%,EM$
690       STOP
800   !
```

**Figure B-5. Example Output/Attenuator Compensation and Level Cal Program (cont)**

```
810  GOSUB 5000                    ! zero power meter
820  TL = 10                       ! flag used to determine when to zero meter
1000 !
1010 ! Main loop
1020 !
1030     ! get frequency, exit main loop on last frequency
1040     PRINT @ A%,"cc_freq?" \ INPUT @ A%,F,UN$
1050     IF (F = 9E9) GOTO 2000
1060     !
1070     ! zero power meter before measuring first 24 dB attenuator
1080     !  (target level changes from -2 dBm to -14 dBm).
1090     PRINT @ A%,"cc_target?" \ INPUT @A%,T,UN$
1100     IF ((T = -14) AND (TL = -2)) THEN GOSUB 5000  ! zero power meter
1110     TL = T
1120     !
1130     ! get power meter reading
1140     GOSUB 4000                    ! reading -> RD
1150     !
1160     ! send power meter reading to 6080A
1170     PRINT @ A%,"cc_rdpower ";RD;" dbm"
1180 GOTO 1000
2000 !
2010 ! Store results
2020 !
2030 PRINT @ A%,"cc_save"          ! save data in compensation memory
2040 IF( CM$ <> "comp_att" ) THEN GOTO 2050
2045     WAIT 45000                ! wait 45 seconds for atten store
2050 PRINT @ A%,"error?" \ INPUT @ A%,ST%
2060 IF (ST% = 0 OR ST% = 79%) THEN GOTO 2900
2080     PRINT ST%
2100     STOP
2900 END
3000 !
3010 ! Subroutine to initialize HP 436A Power Meter
3020 ! P$ is used when zeroing the power meter too
3030 !
3040     P$ = "D+9H"           ! dBm mode, no CAL factor, auto range, Hold
3050     PRINT @ AP%,P$
3060     PRINT @ AP%,"I"       ! get first reading
3070     INPUT LINE @ AP%,RD$ ! throw it away
3080 RETURN
4000 !
4010 ! Subroutine to get readings from HP 436A Power Meter
4020 !
4030 ! Get two readings within .01 dB, then read eight
4040 !   more and return the average of all ten.
4050 !
4060     ! set delay to 200 ms or 400 ms if 24 dB pad
4070     WT% = 200%
4080     IF( T = -14 ) THEN WT% = 400%
```

MP MASTER
MA21808